

FIRE/FUELS SPECIALIST REPORT

BIG JACK EAST

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Big Jack East

Fire and Fuels Report

I. Introduction

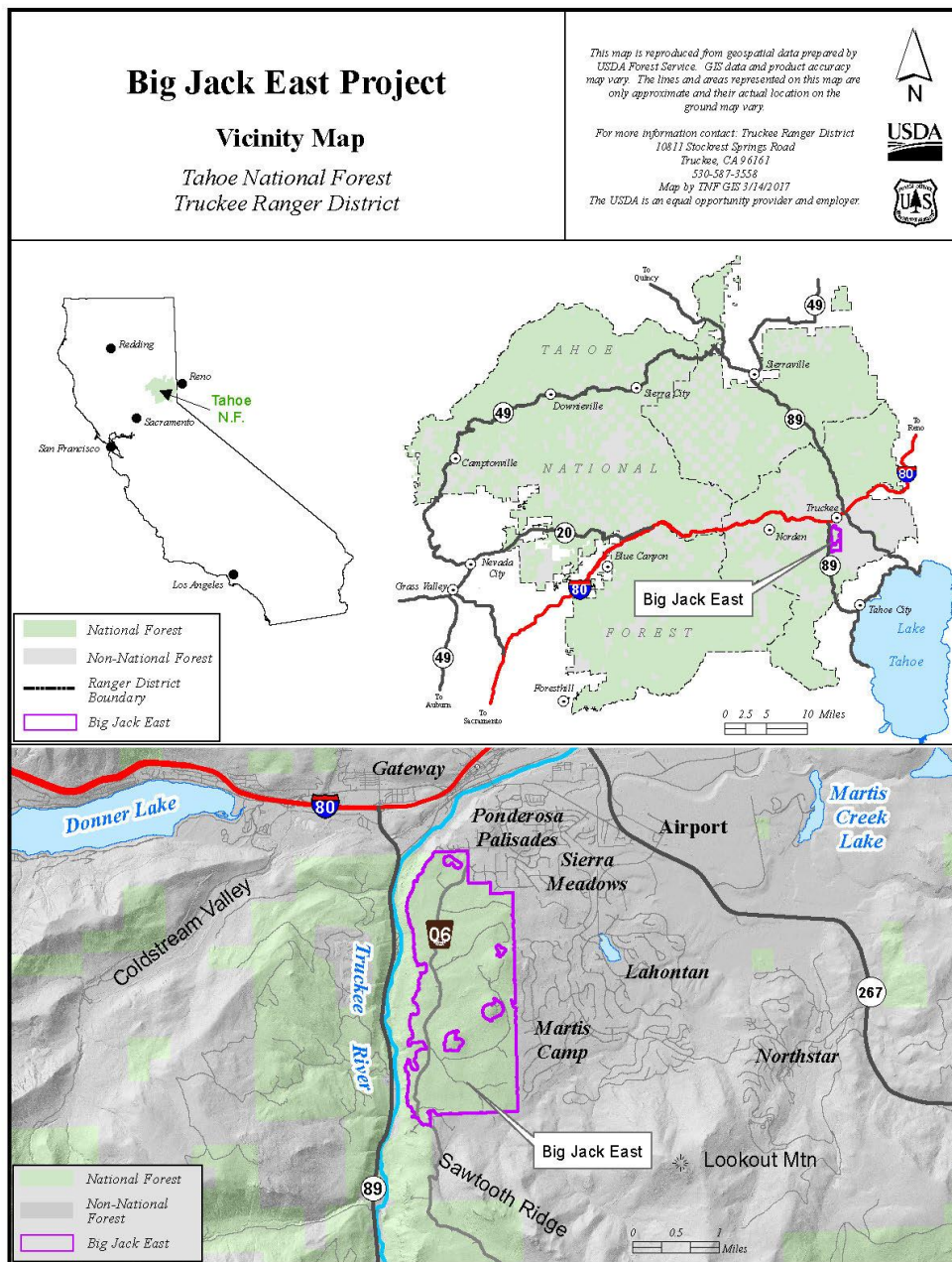
This report discusses the fire and fuels management aspect of the purpose and need to reduce fuel accumulations within the wildland urban intermix and surrounding areas in the Big Jack East (may be referred to as BJE throughout the document) fuels reduction project area. The historical and present role of wildfire on the landscape is discussed as well as the interactions between fire and natural resources within the area. Specifically addressed are the effects to potential fire behavior by the proposed treatments for one action alternative and the existing condition (no action).

Location and Notable Features Overview

The Big Jack East (BJE) Project area is located in northeastern Placer County, California, east of State Route 89 South, west of Martis Valley, and south of the Town of Truckee. In 2001, the Secretary of Agriculture identified Truckee as an Urban-Wildland Interface Community at High Risk from Wildfire ("Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire," 66 Federal Register 3 (4 January 2001). The project area is largely surrounded by private property and it is the figurative backyard to hundreds of Truckee residents. The adjacent communities, including Sierra Meadows, Ponderosa Palisades, Martiswoods Estates, Ponderosa Ranchos and Martis Camp, plus a major utility corridor within the project area elevate the area's need for effective management of the wildland urban intermix (WUI).

The overall project area is approximately 2,059 acres in size. The area has mostly flat to moderately steep terrain, with steeper upper slopes draining into the Truckee River. Elevations range from approximately 6,720 feet to 6,280 feet. The entire project area is managed by the Forest Service, however the project is surrounded by private land on all sides. Much of the privately-owned land is residentially developed. Transmission lines also pass through much of the project area. The area is popular with dispersed recreationists. Uses include mountain biking, trail running, motorcycle riding, horseback riding, snowmobiling, and cross country skiing. The Sawtooth Trail is a highly used mountain bike trail located within the project area. There are also other official and unofficial bicycle trails, and off-highway vehicle trails.

Figure 1 Vicinity Map of the Big Jack East Project Area



The project area is a combination of older forest stands and plantations. Older forest stands encompass most of the project area, while plantations cover less than 25% of the project area. The plantations are highly homogenous in terms of species, genetics, age and structure. Further, the high number of trees per acre is unsustainable and will most likely result in unpredictable and widespread mortality at some point in the near future.

Most of these stands have had some fuels reduction work completed within the last 20 years. Although this work alleviated some resource stress on the remaining trees and increased the stands fire resiliency,

what remains is quite homogenous in terms of genetics, species and structure. This leaves these stands vulnerable to other stand replacing disturbances like a pine beetle outbreak and provides limited habitat diversity for older-forest dependent wildlife.

Portions of the project area have received a successful mix of fuel reduction work, variable levels of thinning, and the reintroduction of prescribed fire. This has created conditions that are much closer to what would have developed had active fire been a more natural influence on forest ecosystems. However, the fuel reduction work that was done has now grown in and needs further treatment.

Purpose and Need related to Fire/Fuels

Wildfire can create either unwanted or beneficial effects to the landscape within the Big Jack East project area. Wildfire exclusion has increased the risk for large severe wildland fires in many ecosystems (Busenberg 2004; Agee and Skinner 2005). Damaged homes related to wildland fires became nationally recognized in 1985 (Cohen 2008). Since 2000, several documents have been published providing direction and/or guidance on hazardous fuels around communities, including the National Fire Plan (2000), Federal Wildland Fire Management Policy (2001), 10-Year Comprehensive Strategy (2001), Healthy Forests Initiative (2002), Healthy Forest Restoration Act (2003) and Protecting People and Natural Resources, A Cohesive Fuels Treatment Strategy (2006). Unwanted wildfires can damage vegetation and soils leading to further degradation of habitat, and water quality. Prescribed fire and mechanical fuel treatments can reduce the potential for damage from unwanted wildfires as well as improve vegetation health, water quantity and quality.

The overriding issue concerning fire and fuels revolves around fire hazard and fire risk. Regrowth of vegetation and reoccurring accumulation of timber litter on the forest floor have resulted in areas conducive to large fire growth. The potential exists for a high severity wildland fire that is uncharacteristic of the historical fire regime. Accumulated fuels through time heighten concerns over fire effects to resources (e.g., wildlife habitat, soils, human uses, hydrology, air quality), public and firefighter safety, and fire behavior potential within and adjacent to the WUI. Numerous fire starts occur every year and are primarily human caused. The entire project area is within the WUI, increasing the risk and hazard of wildfire to humans.

This area within the Tahoe National Forest is a fire adapted ecosystem, fire exclusion and previous management practices have changed vegetation composition, fuel loading, fire frequency and potential fire intensity.

II. Need for the Big Jack East Project

After more than three years of site evaluation, data collection, and communication with interested parties, including the Truckee Fire Protection District which administers the Community Wildfire Protection Plan (CWPP), the Forest Service identified disparities between the existing condition and desired conditions on National Forest lands in the Project Area.

The following section describes why the Forest Service is proposing to take actions now in the Big Jack East project area.

Need 1) Action is needed to reduce fuel loadings and create a safer, more effective fire suppression environment in the wildland urban intermix (WUI)

The Big Jack East project area is entirely in the WUI. Approximately 50% of the project area directly borders private land. According to the Forest Plan the project area currently does not meet WUI desired conditions (described below) due to the quantity and continuity of both horizontal and vertical surface and ladder fuels, as well as the closed canopy structure. Surface fuels are the vegetative fuel on or near the ground surface, consisting of leaf and needle litter, grass, dead branch material, downed logs, bark, pine cones and low growing vegetation. Ladder fuels are the vegetative fuel (small trees and shrubs) which provide vertical continuity between the ground surface and the forest canopy. These fuels can provide a ladder for fire to reach the forest canopy.

If a wildfire were to occur in the existing fuels conditions, during 90th percentile weather conditions, the expected fire behavior would be characterized by flame lengths and fire intensities that would exceed the capabilities of initial attack suppression resources. 90th percentile weather is defined as the severest 10% of the historical fire weather, i.e., hot, dry, windy conditions occurring during the fire season.

Effectively treated WUI lands are needed to provide a safe place for fire suppression resources to engage in suppression activities in the event of a wildfire, to protect National Forest System (NFS) lands from a wildfire started on private lands, and to enhance protection of private lands in the event of a wildfire ignition on NFS lands. Desired conditions, management intents, and management objectives for the WUI land allocations, such as those in the Big Jack East project area, are set by the *Tahoe National Forest Land and Resource Management Plan* (LRMP 1990), as amended by the *Sierra Nevada Forest Plan Amendment Record of Decision* (SNFPA 2004), collectively referred to as the Forest Plan. Forest Plan management direction for the WUI is described in the Management Direction for Defense Zones section and Management Direction for Threat Zones section.

Within the BJE project area a fuelbreak was completed along the 06 Road, also known as the Sawtooth Road, and adjacent to private property roughly 25 years ago. Vegetation has grown within the fuelbreak and needs to be removed to restore the effectiveness of the fuelbreak. The 06 Road is the main road into the Big Jack East Project area. This road is heavily used by the public for forest enjoyment, and it will be utilized for ingress and egress for the public as well as fire personnel in the event of a wildfire.

While some areas in the Big Jack East Project area currently meet desired conditions and do not need fuels management treatments, assessments and fuel modeling indicate that many proposed treatment areas within the project are characterized by a large departure from the fire return interval (FRI). The FRI is the time in years between two successive fires in a designated area, i.e. the interval between two successive fire occurrences. Before European settlement, most of the vegetation communities in the project area historically had a fire occur every 6-10 years. There have been no recorded large-scale wildfires in most of the project area since 1949; however, there have been many smaller fires less than ¼ acre. Normal vegetation growth, without active fire in most of the area, has led to the area becoming dense and overgrown, leaving it susceptible to high-severity wildfire. When fire is excluded from an area where fire would normally occur, to remove fuel build up, other methods of fuel removal need to be addressed/identified. This project is needed to remove fuel accumulations. Areas that meet desired conditions would not need treatment.

Beyond threats to human life and property, a high-severity wildfire in the project area would adversely affect numerous ecological values, including foraging habitat for the California spotted owl and northern

goshawk, as well as riparian habitat and meadows. A severe wildland fire could have substantial adverse effects on water quality in Big Jack East project area, the waters of which enter the Truckee River, which the State of California has listed as being “water quality limited” for sediment under Section 303 (d) of the Clean Water Act. Furthermore, the area contains a substantial number of cultural resource sites, many of which could be negatively affected by a wildland fire.

Need 2) Action is needed to create conditions that would improve forest stand resiliency to fire, insects, disease, drought and climate change

Historic forest characteristics within the Big Jack East project area prior to the modern era of aggressive fire suppression included lower amounts of surface fuels, lower densities of ladder fuels, more open crown densities, and higher percentages of larger fire resistant overstory trees. Prior to Comstock era logging and fire suppression, a variety of tree species, age classes, and seral stages were represented throughout the project area. Stands developed with a natural fire return interval which created a forest structure composed of areas of large diameter trees intermixed with openings and areas containing a variety of vegetation seral stages (Leiberg 1902; Gruell 2001). Due to this variability, these stands were more resilient to disturbances such as wildland fire, insects, disease and drought (Stephens and Sugihara 2006; Skinner et al. 2005). Compared to the forest conditions of today, historical forest conditions provided for a more fire adapted ecosystem with more frequent and less intense fires.

The heterogeneous and resilient forested stands that were once common in eastside Sierra Nevada forest types that comprise the Big Jack East project area are now generally homogenous tree stands of similar ages, species and genetics. The transition to current homogeneous stands in the Big Jack East project area began with large scale Comstock-era logging that essentially clear-cut much of the area. These unnaturally large openings slowly re-vegetated under management emphasizing fire suppression. This further prevented stand conditions from forming into spatial forest patterns that are more consistent with eastside conifer forests that historically experienced active, natural fire. In 1949, the Bald Mountain Fire burned approximately 328 acres within the project area. Plantations were established within the burned area as well as other areas throughout the project. The trees in these plantations are similar in age and size therefore lack heterogeneity. Outside the plantations, a majority of the project is still an artifact of Comstock-era logging followed by fire suppression management and remains homogeneous in nature.

Approximately fifty percent of the Big Jack East area was treated under the Bullshead project from 1997 through 2002. The Bullshead project included thinning of the forest stands for forest health, salvage of dead and dying trees, and a sanitization cut to remove mistletoe infested trees. Trees down to six inches diameter breast height were also removed in some locations. Fuels reduction treatments such as mastication and pile burning were also completed on a much smaller scale within the Bullshead project. The Bullshead treatments were completed almost 20 years ago and over the years, younger vegetation, both shrubs and conifer trees, have filled in creating consistent horizontal and vertical ladder fuels.

Prolonged drought and tree overcrowding increase the risk of tree mortality in forested areas stressed by insects and disease. Although cycles of mortality are normal, the Truckee Ranger District has many forested areas experiencing mortality from the current suite of stressors, with some increased tree mortality evident in portions of the Big Jack East project. Annual forest health assessments completed by Forest Service forest health experts have indicated that the Big Jack East project area has been

experiencing a decline in forest health. The *2012 National Insect and Disease Risk Map* (NIDRM) and its associated reports (Krist, et al., 2014) contain a strategic assessment of the hazard of tree mortality due to insects and diseases. Risk, or more appropriately termed hazard, is defined as: the expectation that, without remediation, at least 25% of standing live basal area greater than one inch in diameter will die over a 15-year time frame (2013 to 2027) due to insects and diseases. NIDRM classified much of the Big Jack East Project area as “at risk” under this classification system (Krist, et al., 2014).

Many stands in the Big Jack East project area would benefit from restorative treatment to increase heterogeneity and therefore resiliency, as suggested in recent studies by North et al. (2009 and 2010) and others. The current conditions in forest stands have made them more vulnerable to a host of mortality factors including drought stress, beetle outbreaks, disease, and the over-arching ramifications of climate change. Excessive tree mortality can have significant and long-term effects on forest structure and composition, and these conditions can exacerbate the impacts of drought, fires, insects, and diseases. Action is needed to develop forest stands that can be more resilient to severe disturbance effects. Enhancing forest heterogeneity at both the stand and landscape-scale, reducing stand densities in certain locations, and modifying tree species composition (for example, favoring more fire resilient pines over fir on south facing slopes) could address the potential for tree mortality due to drought, insects, disease, and fire. Climate change is anticipated to aggravate these stressors; hence, action is needed to enable stands in the Big Jack East Project area to be more resilient under changing future conditions.

III. Regulatory Setting (Applicable Laws, Policies, and Regulations)

The Big Jack East Project will follow the *Tahoe National Forest Land and Resource Management Plan* (1990) as amended by the Sierra Nevada Forest Plan Amendment (2004) (referred to as the Forest Plan).

A wildland urban interface/intermix (WUI) defense zone surrounds the immediate vicinity of the Big Jack East Project Area, and the defense zone is buffered by a WUI threat zone. The Healthy Forest Initiative (HFI) for Wildfire Prevention and Stronger Communities signed into law by President Bush on August 22, 2002, implements core components of the National Fire Plan and the 10-year Comprehensive Strategy, which were developed after the devastating 2000 fire season and agreed to by states, tribes, and stakeholders. Both provide direction for prioritizing treatment in areas that are at risk of severe wildland fires, especially communities in the WUI, in order to protect communities, firefighters, wildlife, and forest health. The proposed treatments for the Big Jack East Project would further the goals of the HFI.

Tahoe National Forest Land Resource Management Plan

Tahoe National Forest Land and Resource Management Plan (LRMP 1990), as amended (Forest Plan) provides management direction for the National Forest System (NFS) lands located within the Big Jack East Project Area. The Project area is almost entirely within Forest Plan Management Area 068 Sawtooth but also touches Management Area 069 Truckee River in very small portions on the western edge of the project area. The Sawtooth Management Area (MA) is located east of the Truckee River MA069 from the Nevada-Placer County line on the north to the Lake Tahoe Basin Management Unit on the south within the Truckee River watershed.

Reducing the threat to communities and wildlife habitat from large, severe wildfires. (SNFPA ROD, 2004): A major need driving development of the big Jack East Project is to reduce the threat to the surrounding land and wildlife habitat from large, severe wildfires. The vegetation and fuels treatments

under Alternative 1 would modify landscape scale fire behavior to the benefit of the Project area and meet this goal. Under Alternative 2, no action is proposed and existing trends would continue.

The BJE Fire and Fuels report (incorporated by reference and available upon request) was summarized in FONSI element 1. The following shows how the proposed action is consistent with the Fire and Fuels Standards and Guidelines in the SNFPA ROD 2004. Standard and Guideline #3, which provides fuels management direction for plantations comprised of seedlings and saplings, is generally not applicable to this project.

Standard and Guide (S&G) 1: “Strategically place area fuels treatments across the landscape to interrupt fire spread and achieve conditions that: (1) reduce the size and severity of wildfire and (2) result in stand densities necessary for healthy forests during drought conditions. Complete a landscape-level design of area treatment patterns prior to project-level analysis. Develop treatment patterns using a collaborative, multi-stakeholder approach. Determine the size, location, and orientation of area fuels treatments at a landscape-scale, using information about fire history, existing vegetation and fuels condition, prevailing wind direction, topography, suppression resources, attack times, and accessibility to design an effective treatment pattern. The spatial pattern of the treatments is designed to reduce rate of fire spread and fire intensity at the head of the fire” (SNFPA ROD, pg. 49).

The entire project was designed to interrupt fire spread. The proposed treatments would reduce the size and severity of wildfire and result in stand densities necessary for healthy forests during drought conditions. Vegetation within treatment areas would be modified to meet desired surface ladder, and crown fuel conditions and reduce fire intensity, rate of fire spread, crown fire potential, mortality in dominant and co-dominant trees, and tree density.

The Truckee Fire Protection District Community Wildfire Protection Plan (CWPP) was completed in 2016 by the Truckee Fire Protection District. The CWPP was collaboratively developed, and the United States Forest Service, Tahoe National Forest, Truckee Ranger District mutually agreed with the contents of the CWPP. Policy and law including the Federal Register Volume 66, Number 3 (Thursday, January 4, 2001), The Healthy forest Restoration Act (2003), and the Cohesive Wildland Fire Management Strategy (USDI and USDA, 2006) all guided the development of the CWPP as well as its collaborative development between the Truckee Ranger District and the involved entities. The Truckee CWPP states that, “Many changes have occurred to the terminology that surrounds the definition of a WUI area, but the basic definition is unchanged. The WUI today is broken into two distinct areas, the defense zone is the area within 0.5 miles of the urban core and the threat zone is the area within 1.25 miles of the defense zone,” (pg. 19). This definition differs from Forest Plan direction in the 2004 SNFPA ROD pertaining to delineating wildland urban intermix zones: the defense zone extends out roughly 0.25 miles from developed private lands and threat zone generally extends approximately 1.25 out from the defense zone (SNFPA ROD, pg. 40). Both the CWPP and the Forest Plan are aimed at the same outcome: to reduce the fire behavior in the WUI under extreme weather conditions so that suppression resources can adequately engage the fire before it reaches the homes and other important community infrastructure. Treatments in defense zones are designed to result in flame lengths less than 4 feet and rates of spread slow enough for ground resources to suppress the fire. As described under the Fire and Fuels section under Intensity Element #1 of this chapter and in the Big Jack East Fuels Specialist Report, which is incorporated by reference, the proposed treatments would reduce flame lengths, rate of spread and initiation of crown fire throughout the entire Big Jack East Project area.

During refinement of the Proposed Action in association with information received during scoping, Truckee Ranger District staff met with leadership from the Truckee Fire Protection District in multiple

meetings to coordinate consistency with the Community Wildfire Protection Plan (CWPP). This collaboration was used to adjust and refine the Proposed Action to assure consistency with the SNFMPA (2004) and the Truckee CWPP.

S&G 2: “Vegetation within treatment areas should be modified to meet desired surface ladder, and crown fuel conditions as well as stand densities necessary for healthy forests during drought conditions. Site specific prescriptions should be designed to reduce fire intensity, rate of fire spread, crown fire potential, mortality in dominant and co-dominant trees, and tree density. Managers should consider such variables as the topographic location of the treatment area, slope steepness, predominant wind direction, and the amount and arrangement of surface, ladder, and crown fuels in developing fuels treatment prescriptions” (SNFPA ROD, pg. 49).

The Proposed Action (Alternative 1) would interrupt potential fire spread by strategically placing treatments across the landscape as the entire Project area would be treated as a continuous landscape treatment. Alternative 1 would remove sufficient material in treatment areas to cause a fire to burn at lower intensities and slower rates of spread compared to untreated areas. The treatments proposed within the defense zone meet SNFPA ROD defense zone desired conditions (pg. 45) by creating fairly open forest stands that would be dominated primarily by larger, fire tolerant trees. The removal of surface and ladder fuels would make conditions so that crown fire ignition would be highly unlikely. The openness and discontinuity of crown fuels, both horizontally and vertically, would result in very low probability of sustained crown fire within the defense zone.

The treatments proposed within the threat zone would meet SNFPA ROD threat zone desired conditions (pg. 46) by reducing flame lengths on average to less than 4 feet and rates of spread would decreased by 50 percent (Refer to the Fire and Fuels section under Intensity Element #1 of this Chapter). Hazards to firefighters would be reduced by managing snag levels in locations likely to be used for control of prescribed fire and fire suppression consistent with safe practices guidelines. Production rates for fire line construction would be doubled from pre-treatment levels under the proposed action. Further, tree density would be reduced to a level consistent with the site’s ability to sustain forest health during drought conditions. There may be small areas, such as leave areas, that could have small localized higher flame lengths and higher rates of spread. However, these small leave areas are within larger treatment units in which average flame lengths would be less than 4 feet and rates of spread decreased by 50 percent, allowing fire fighters to engage effectively in fire suppression efforts.

S&G 4: “Design mechanical treatments in brush and shrub patches to remove the material necessary to achieve the following outcomes from wildland fire under 90th percentile fire weather conditions: (1) wildland fires would burn with an average flame length of 4 feet or less and (2) fire line production rates would be doubled. Treatments should be effective for more than 5 to 10 years” (SNFPA ROD, pg. 50).

The mechanical treatment of brush and shrub patches to achieve required outcomes is a key part of the Proposed Action. Each treatment unit is assigned a ‘vegetation management tool’ with an associated ‘surface fuel management tool’. In combination, these tools would act together to ensure treatment unit-specific conditions, including a shrub component, would be managed to meet fuels objectives. In many treatment units, mechanical tree removal (for instance cut to length or whole tree yarding) is not needed. In these cases, biomass removal followed by mastication or grapple piling would be used to cut and remove the small diameter trees, brush, and shrubs to meet desired conditions for the unit.

S&G 5: “Design a sequence of fuel reduction treatments in conifer forest types (including 3x plantation types) to achieve the following standards within the treatment area:

- an average of 4-foot flame lengths under 90th percentile weather conditions.
- surface and ladder fuels removed as needed to meet design criteria of less than 20 percent mortality in dominant and codominant trees under 90th percentile weather and fire behavior conditions.
- tree crowns thinned to meet design criteria of less than 20 percent probability of initiation of crown fire under 90th percentile weather conditions” (SNFPA ROD, pg. 50).

Plantations in the project area are classified as 3x plantation types (6-11inch dbh trees). An average of 4-foot flame length under 90th percentile fire weather conditions would occur in these units after treatment. Tree mortality in dominant and co-dominant trees under 90th percentile weather would be less than 20 percent after treatment. The initiation of crown fire under 90th percentile weather conditions would meet design criteria of less than 20 percent probability.

IV. Environmental Setting

Eastside Pine Forest

The primary vegetation type within the project area is eastside pine forest with some mixed conifer. Eastside pine forests are dominated by ponderosa or Jeffrey pine, with lesser amounts of white fir, incense cedar and juniper. Common shrub species include sagebrush, bitterbrush, snowbrush, and manzanita. Other characteristics of eastside pine forests include large meadows, abrupt transitions from wet to dry habitats and major vegetation change by aspect. The heterogeneous and resilient tree stands that were once common in this forest type were those that naturally combined pockets of large diameter trees with pockets of early seral vegetation. These are now largely replaced with homogenous stands of similar tree ages, species and genetics.

Existing Fuel Complex

In general, throughout the analysis areas there is a large variation in fuel loading at different amounts. Fuel loadings can vary from <1 tons per acre in open to >30 tons per acre in heavily timbered stands. Ladder fuels are present throughout the area, ranging from sparse to very dense thus allowing for isolated torching and crown fire to develop within a large portion of the analysis area. This increased potential for surface fires to develop into crown fires is because the understory ladder fuels lower the effective canopy base height and the overstory trees are denser allowing for crown fire initiation and spread. Scott and Reinhardt (2001) define canopy base height as the lowest height above ground at which there is significant canopy fuel to propagate fire vertically through the canopy.

Canopy base height, canopy bulk density and canopy continuity are key characteristics of forest structure that affect the initiation and propagation of crown fire (Rothermel 1991). Canopy base height is important because it affects crown fire initiation. Continuity of canopies is more difficult to quantify, but clearly patchiness of the canopy will reduce the spread of fire within the canopy stratum.

Weather and Climate

In a normal year, a pacific high pressure system begins to develop in the spring in the BJE project area. Precipitation declines and temperatures gradually increase. This warming and drying trend leads to the

beginning of fire season in the BJE project area by the middle of June or July. Fire season is the time of year when fires are likely to occur. Due to Big Jack East's elevation, snow tends to remain on north and eastern slopes sometimes to mid-July. However, the snow on south and western slopes will begin to melt much earlier. From June through September, the little rainfall that occurs comes from thunderstorms. Rainfall amounts are usually light and short in duration. During this period, the weather is warm and dry with temperatures in the low to mid 80s and relative humidities in the teens at the 6,000-foot elevation. Wildfire ignitions by lightning are common. The high pressure of summer begins to break down by mid-September. Although dead fuel moisture levels can remain quite low, the heat of the summer is gone. Fire season usually ends by mid-October in the BJE project area.

The BJE project area has a Mediterranean type climate with cold, wet winters and warm, dry summers. Annual precipitation is about 30.15 inches; snowfall accounts for greater than 80 percent of the annual precipitation. The annual total snowfall is 201 inches. The Western Regional Climate Center has a weather station at Truckee, CA and has been collecting weather data since 1904. The weather station is about 2 miles from the BJE project area. Table 1 displays the average precipitation from 1904 to 2016.

Table 1: Period of Record Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	39.2	41.9	46.7	53.7	63.0	72.9	82.3	81.2	74.4	63.4	49.5	40.8	59.1
Average Min. Temperature (F)	14.6	16.7	21.0	26.2	32.3	37.4	41.7	40.3	35.8	29.0	22.3	16.1	27.8
Average Total Precipitation (in.)	5.79	5.02	4.28	1.96	1.31	0.59	0.35	0.35	0.63	1.52	3.25	5.11	30.15
Average Total Snowfall (in.)	48.3	41.9	37.4	15.3	4.1	0.4	0.0	0.0	0.4	2.8	16.2	34.9	201.8
Average Snow Depth (in.)	21	28	22	9	1	0	0	0	0	0	2	11	N/A

Values at Risk

There is substantial risk that a wildfire could start in any of the highly populated or recreated areas near or within the Big Jack East area during a period of low fuel moistures. Under such a scenario, a fire starting in or entering the project area would likely be characterized by extreme fire behavior, with high flame lengths and high rates of spread. There is also the possibility of a fuel-driven wildfire from the southwest in which fire would move through the even-aged plantations in the within the project area. The high vegetation densities in these plantations, combined with the short distance from the ground to the live crowns of the trees, would cause the fire to spread rapidly.

A rapidly spreading wildfire in the project area would be a significant risk to human life and property. A wildfire would also threaten major infrastructure such as electrical transmission lines. Furthermore, it

would adversely affect numerous ecological values, sensitive habitats, including riparian habitat, aspen stands, and meadows. A severe wildland fire could have substantial adverse effects on water quality. The State of California has listed the Truckee River as being “water quality limited” under Section 303 (d) of the Clean Water Act. Finally, the area contains a substantial number of cultural resource sites, many of which could be negatively affected by a wildland fire.

Fire History, Current Condition and Desired Condition

The most widespread fire regime east of the Sierra Crest is one of frequent, low to moderate-intensity fires. Historically forest stands were multi-aged and had a high degree of spatial complexity at the landscape level. Mean fire return intervals were in the range of 6 to 10 years with fire return intervals being longer on north slopes (Skinner et al. 2006).

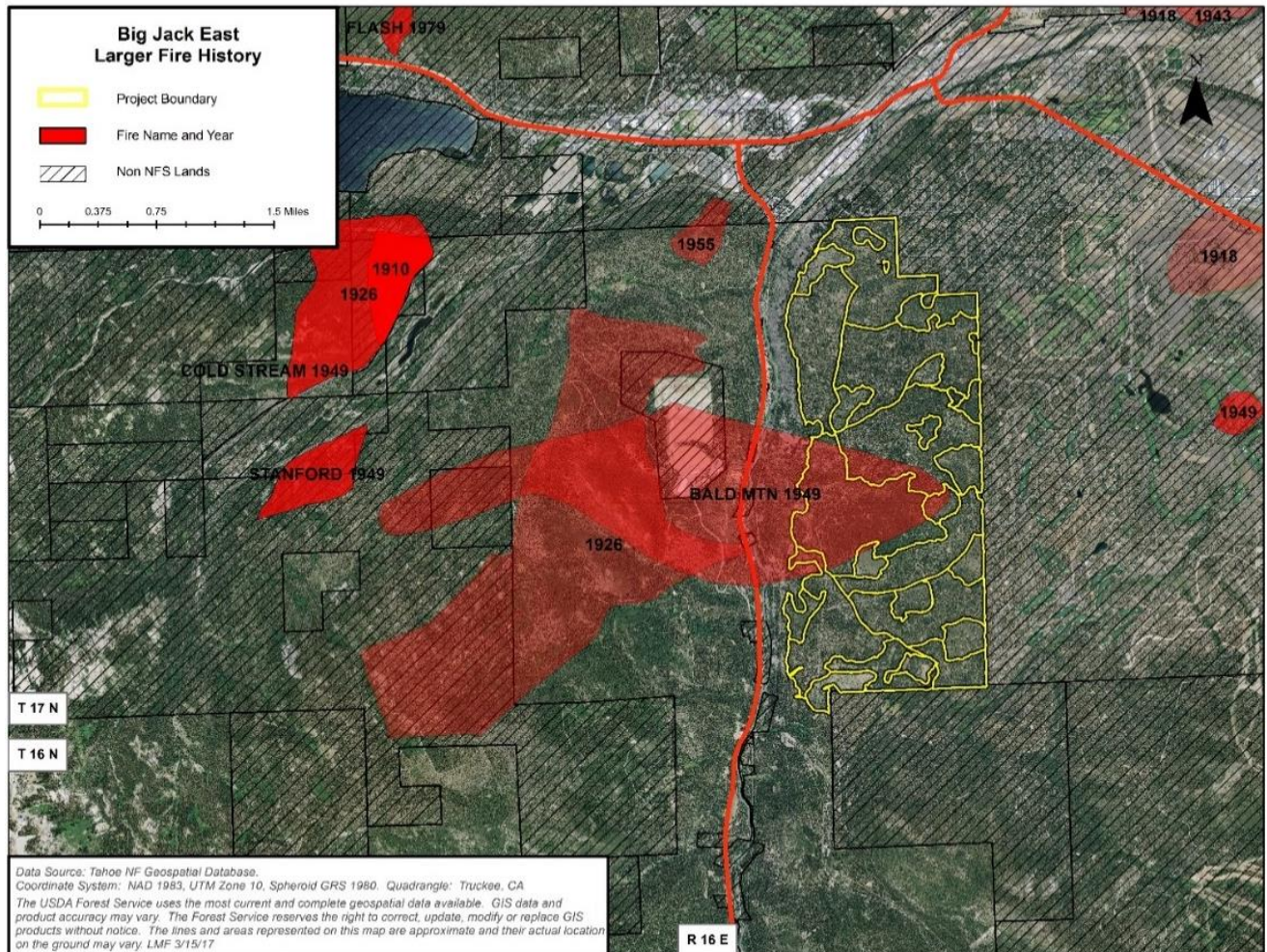
Stand and vegetation structures, along with severity patterns within this regime are highly dependent on the complex combination of topography, vegetation, and weather (Agee 2007, Skinner et al. 2006). Generally, upper slope positions and south- and west-facing slopes burn at higher frequencies and with higher severities than lower slope positions and north- and east-facing slopes. Spatial variation in soil productivity, in conjunction with steep slope gradients and changes in aspect, controls the rate of dead fuel accumulation (Skinner et al. 2006).

Fire has played a major role in shaping the vegetation, composition and structure in the analysis area which extends through the low to mid-montane ecological zones and can be characterized by frequent fires of low-to mixed severity. Lightning, Native Americans, and early European settlers were primary factors shaping the vegetation and creating primarily multi-aged stands (Skinner et al. 2006).

Fire suppression began in the region in 1905 and became increasingly effective over the next 40 years. As fire suppression effectiveness increased, shade tolerant species became established in the understory and forest density has increased. This has resulted in a reduction in spatial complexity as vegetation becomes more homogeneous (Skinner et al. 2006). The fire rotation interval has increased from 20 to 238 years. Over the 400 years prior to effective fire suppression, there are no comparable fire-free periods within the bioregion where large landscapes went decades without simultaneous large fires (Skinner et al. 2006). Existing vegetative conditions are altered from those that would have historically occurred under natural fire regimes. This departure from its historical range is primarily caused by fire suppression, and conversion of forests for human use (e.g. homes, roads, logging, etc.). Deviation from historical fire regimes caused by fire suppression has been most impactful to drier forests dominated by ponderosa pine and larger diameter Douglas fir. In these forest types, fires of low-intensity (non-lethal surface fires) would have controlled regeneration of shade-tolerant tree species (Arno and Allison-Bunnell 2002) and promoted fire-tolerant species. Today, these dry forest types in the analysis area have an accumulation of understory fuels and vegetation, increased ladder fuels, fewer large trees, and an increased potential for crown fires. This increased potential for surface fires to develop into crown fires is because the understory ladder fuels lower the effective canopy base height and the overstory trees are more dense, allowing for crown fire initiation and spread. The current fire regime would be best

described as low frequency, high intensity, stand replacing fire. Fire severity would be high with all but occasional larger trees being killed.

Map 1: Recent Larger Fire History Map of the Big Jack East Project Area

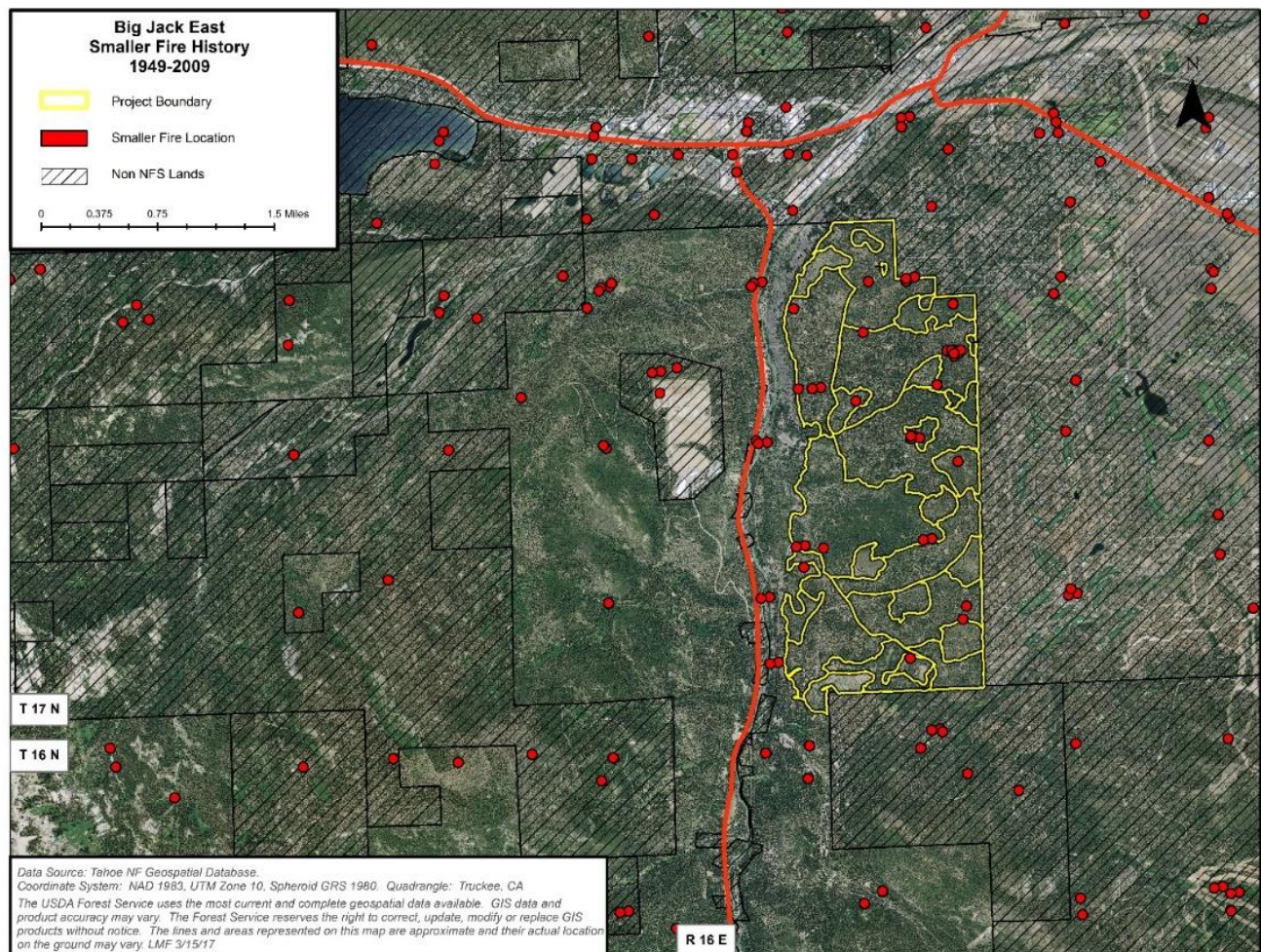


Although there have been hundreds of smaller fires, There has only been one larger fire within the project area since the USFS began recording fires in 1908. Larger fires are defined as fires larger than 100 acres in this document. The Bald Mountain Fire (1,465 acres) occurred in 1949 and was the last stand-replacing fire to impact the area. There have been larger fires that have occurred outside the project area such as the Martis fire in 2001 and the Crystal, Hirschdale and Cottonwood fires of 1994. Fire behavior is based on wind, fuel and topography. Wind is also the most dynamic and changing of the forces that move a fire. The typical wind pattern for the area is from the southwest moving towards the northeast.

Approximately 32 smaller fires have occurred within the project area between 1949 and 2017 with an additional 41 fires having occurred within one mile of the project boundary, see Map 2. These smaller fires are considered Class A and Class B; (Class A fires are 0-.25 acres and Class B fires .26 to 9.9 acres). Suppression resources have been effective at extinguishing these smaller fires in the past. It is likely

that these smaller fires have not occurred on dry windy days or they have been spotted quickly making suppression more successful.

Map 2: Recent Smaller Fire History Map of the Big Jack East Project Area



The majority of fire starts within the project area are from summer lightning storms that track across the Tahoe National Forest. Although the great majority of fire starts are caused by lightning, most of the acres burned are from human caused fires. Human caused fires such as the Cottonwood (1994) and Martis (2001) Fires tend to be harder to control because they can be ignited during low humidity and/or high winds, where lightning fires are usually accompanied by higher humidity and precipitation and are therefore easier to control when spotted. Also, there is a higher degree of success suppressing lightning fires due to advanced technology. During and after lightning storms, maps are available to fire suppression crews which display where each lightning strike hits the ground. In addition, reconnaissance flights are used to fly an area that has been hit by lightning to identify any fire starts. Once spotted, these fires usually get suppressed soon after notification.

Map 2 displays how many smaller fires the Big Jack East Project Area has experienced since 1949. The project area generally gets 6-10 fire starts per year. The smaller fires are a mix of lightning and human

caused activity. Ignition within the project area is almost an annual certainty while history shows (Map 1) that the potential for one of these ignitions to become larger in size with higher intensities is also quite probable when current fuel conditions are considered.

Overview of fire regimes, fire return intervals (FRI) and fire regime condition classes (FRCC)

All map data was derived from Landfire and the FRCC guidebook found at <https://www.landfire.gov/>

Natural Fire Regimes

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human intervention but including the possible influence of aboriginal fire use (Agee 1993; Brown 1995; Brown and Smith 2000). FRCC Guidebook version 3.0, September 2010 Chapter 2 15 Coarse-scale definitions for natural fire regimes were initially developed by Hardy and others (2001) and Schmidt and others (2002) and subsequently re-interpreted by Hann and Bunnell (2001). The five natural fire regime groups are classified based on the average number of years between fires (fire frequency or mean fire interval [MFI]) combined with characteristic fire severity reflecting percent replacement of dominant overstory vegetation. These five natural fire regimes are defined as follows: These five regimes include:

Table 2 Fire Regime Groups

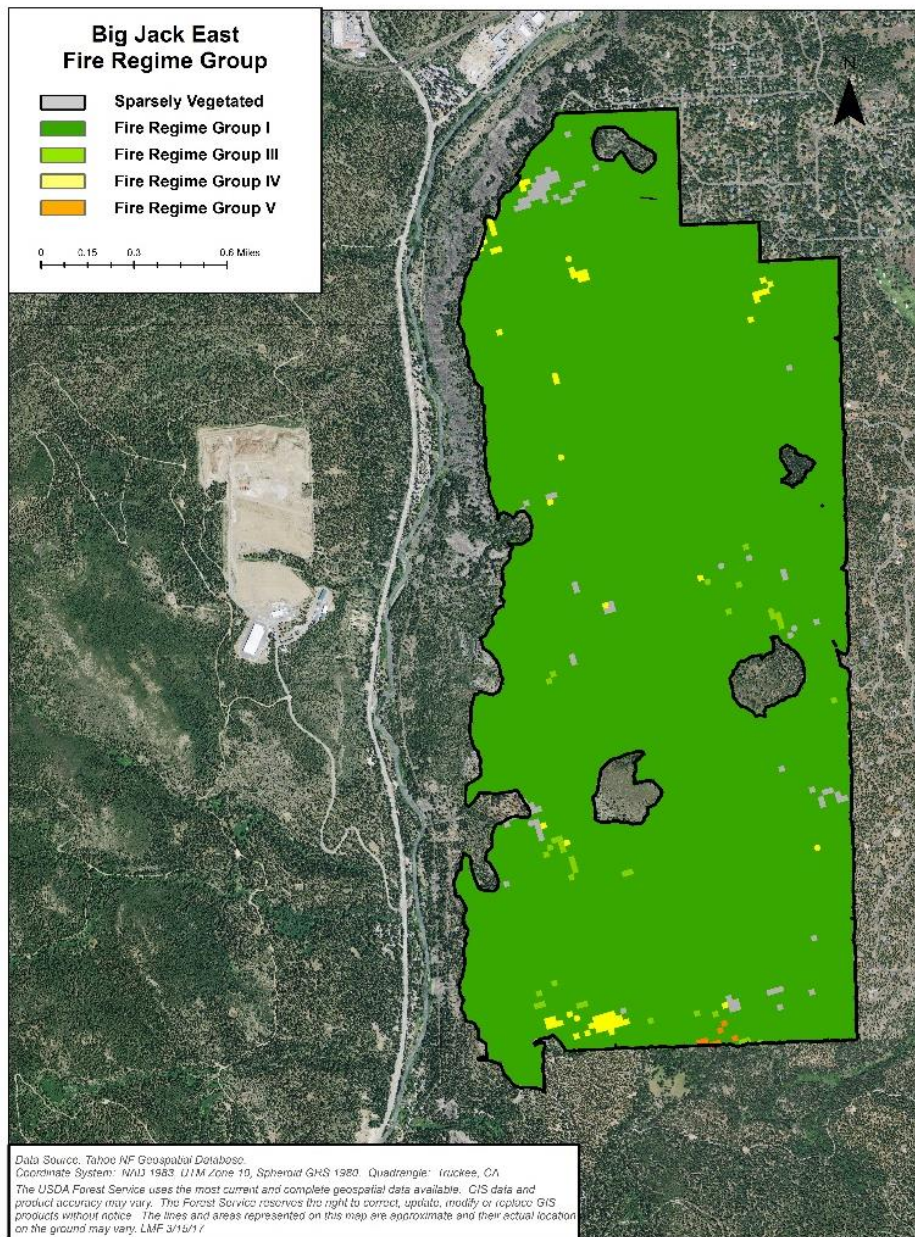
Group	Frequency	Severity	Severity Description
I	0-35 years	Low-mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory
II	0-35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation
III	35 – 200 years	Low-mixed	Generally mixed-severity; can also include low severity fires
IV	35 – 200 years	Replacement	High-severity fires
V	200+ years	Replacement/ any severity	Generally replacement severity; can include any severity type in this frequency range

Fire Regime Impact to WUI

The fire regime in the BJE project area is now shifting towards one of infrequent higher severity fires due to the increase in flammable vegetation which has increased the potential for crown fire. Crown fires are considered the main threat to ecological and human values and they are one of the biggest challenges of fire management. Fire managers recognize three different types of crown fires. *Passive crown fires* kill individual trees or small groups of trees. Passive crown fires are often referred to as “torching”. *Active crown fires* are continuous. They burn the entire tree canopy but they are dependent on heat from surface fires for continued spread. *Independent crown fires* also burn the entire tree canopy but they are independent of surface fires. Independent crown fires, which are rare, only occur in the most extreme situations and are poorly understood. Passive and active crown fires are the main concern for

the project area because of the current fuel conditions proposed for treatments (dense, unnatural fuel loads, ladder fuels and regeneration).

Map 3 Fire Regimes within the Big Jack East project area



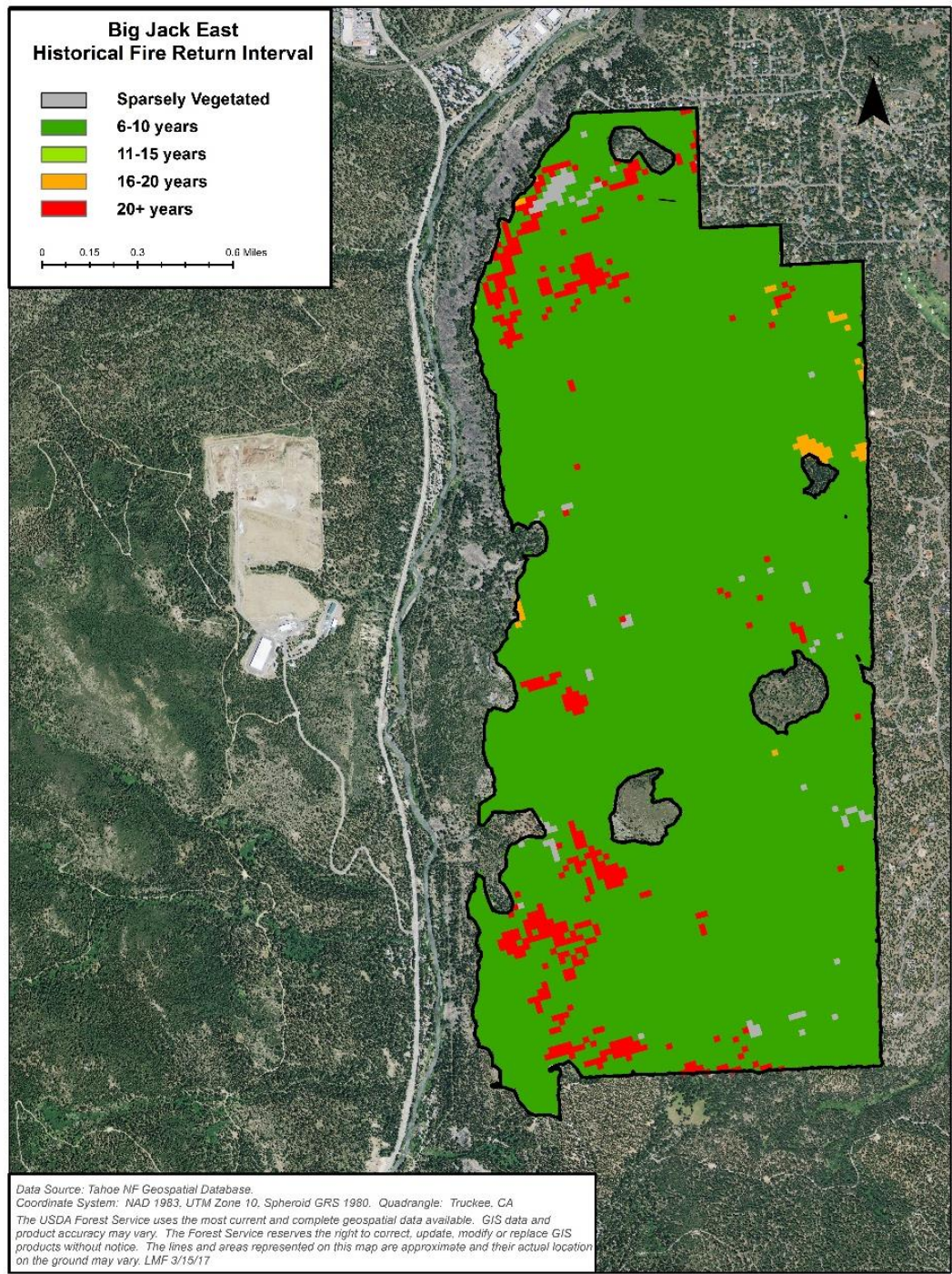
Map 3 displays the fire regime in the BJE project area. The BJE project area is primarily in fire regime I which is a 0–35-year frequency, low to mixed severity, active fire regime. In the BJE project area, fire historically entered any given area between 0-35 years and was of a low severity type with a mix of surface fire and some passive crown fire. Since fires were so frequent, it was common that a fire would start and move until it ran out of fuel to carry the fire, which could be an older fire scar or a natural barrier. Areas in drainages and the Sierra Crest are mostly in a Fire Regime III. These areas were on a 35-100+ year frequency which is less active but tend to burn at higher severities.

Fire Return Interval

Fire Return Intervals (FRI) are the time in years between two successive fires in a designated area, i.e. the

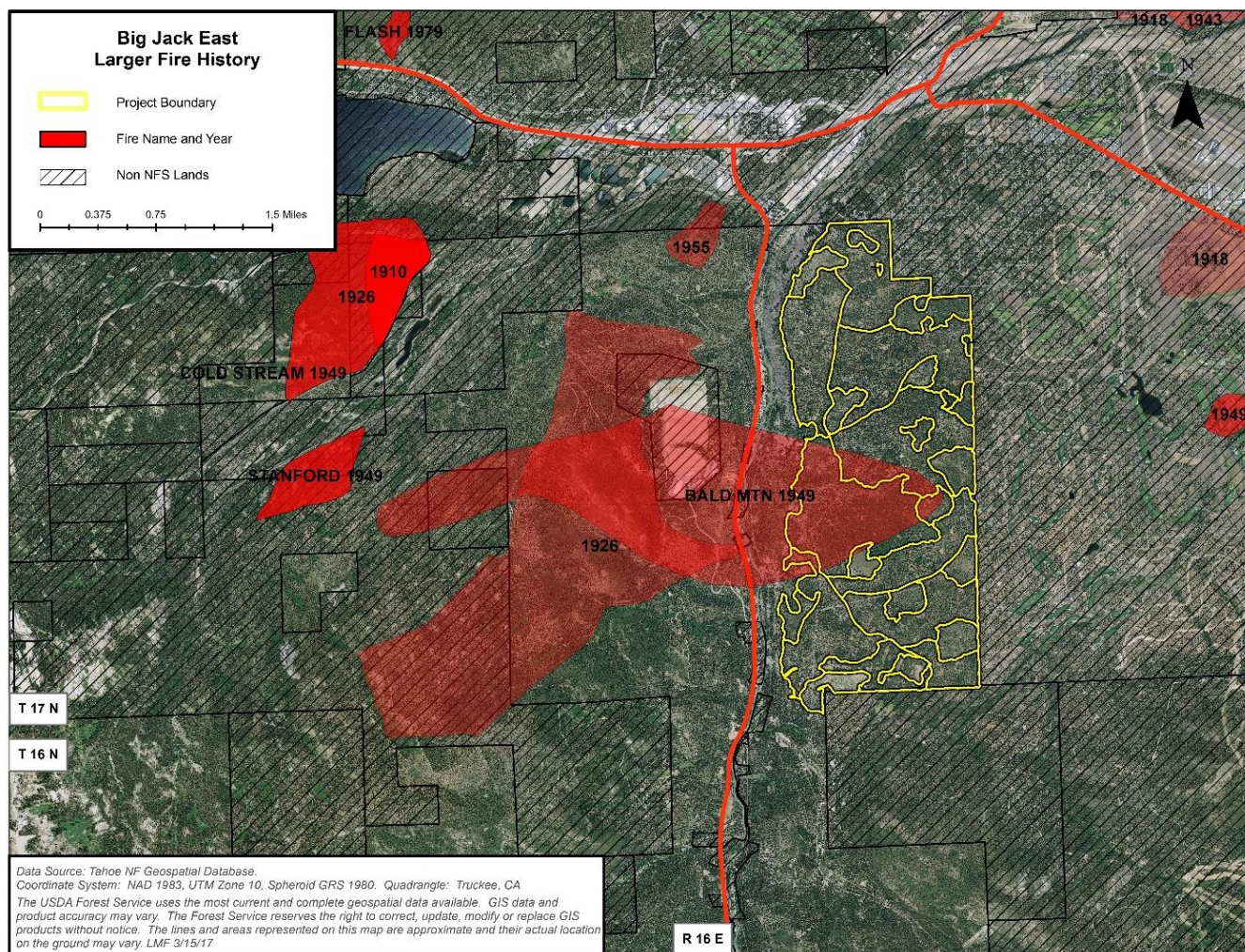
interval between two successive fire occurrences. As shown in Map 4, fire return intervals varied but returned at an average of every 6-10 years within the BJE project boundary before pre-Euromerican settlement (i.e., before the middle of the 19th century).

Map 4- Historical or natural fire return interval



Current FRI: The majority of the BJE project area is currently missing several fire return intervals. The last larger fire to enter the area was the Bald Mountain Fire in 1949 which burned a total of 1,465 acres; 328 of those were within the project area. There have been many smaller fires in the area, however these fires have not burned enough acres to make a difference in fuel reduction that larger fires do.

Map 5: Current Fire Return Interval within the Big Jack East Project Area



Map 5 illustrates the current fire return interval. This maps shows that the entire BJE project area is not burning in intervals consistent to what has historically or naturally occurred defined by the natural/historical fire return interval (Map 4). The naturally occurring fires that would have been left to burn are now being suppressed. Subsequently, with suppression, fuel loading continues to build year after year, setting up current conditions for a larger stand replacing fire. Therefore, for an area that should be burning every 6-10 years there is a potential for larger fires to occur.

Fire Regime Condition Class Descriptions

Fire regime condition classes reflect the current conditions' degree of departure from modeled reference conditions. FRCC assessments measure departure in two main components of ecosystems: 1) fire regime (fire frequency and severity) and 2) associated vegetation. Managers can use the departure and condition class data to document possible changes to key ecosystem components (Schmidt and others 2002). Examples include vegetation characteristics (species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought. Common

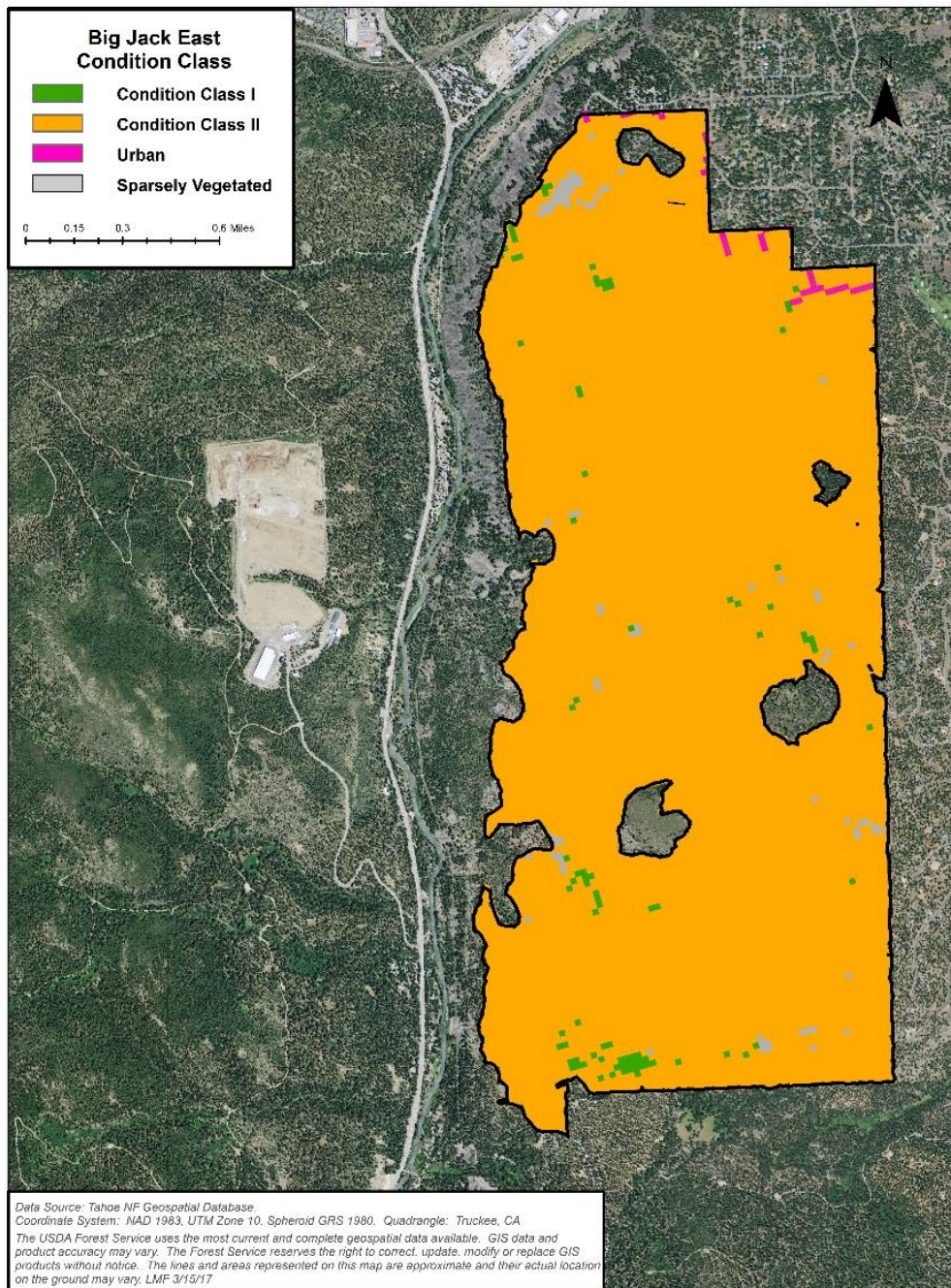
causes of departure include advanced succession, effective fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease (Brown and Smith 2000; Schmidt and others 2002; Brown and others 2004; Hood and Miller 2007; Tausch and Hood 2007; Stambaugh and others 2008; Keane and others 2009). The three fire regime condition classes have been defined (Schmidt and others 2002) as follows: 1) FRCC 1 represents ecosystems with low (66 percent) departure from reference conditions (Hann and Bunnell 2001; Hardy and others 2001; Schmidt and others 2002). As discussed below, departure is based on a central tendency (or mean) metric that represents a composite estimate of the reference condition vegetation and fire regime characteristics.

Characteristic conditions are defined as those occurring within the natural fire regime and associated vegetation (for example, low departure [FRCC 1]). Stated another way, characteristic conditions are those described in available biophysical settings models. In contrast, uncharacteristic conditions are those that did not occur within the natural regime, and hence produce an FRCC 3 (high departure) assessment outcome. Uncharacteristic conditions include (but are not limited to): invasive species (weeds and insects), diseases, “high graded” forest composition and structure (in which, for example, large fire-tolerant trees have been removed and small fire-intolerant trees have been left within a frequent surface fire regime), or overgrazing by domestic livestock that adversely impacts native grasslands or promotes unnatural levels of soil erosion.

Table 3: Fire Regime and Condition Class descriptions.

Condition Class	Fire Regime	Example management options
Condition Class I	Fire regimes are within a historical range and the risk of losing key ecosystem components is low. Vegetation attributes (species, composition and structure) are intact and functioning within historical range.	Where appropriate these areas can be maintained within the historical fire regime by treatments such as fire use and prescribed fire.
Condition Class II	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.	Where appropriate, these restoration treatments, such as fire use, prescribed fire and hand or mechanical treatments will help restore areas to the historical fire regime.
Condition Class III	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.	Where appropriate, these areas may need high levels of restoration treatments, such as hand or- mechanical treatments, before fire can be used to restore the historical fire regime.

Map 6 Current Condition Class



Map 6 displays that the majority of the Big Jack East project area is in Condition Class II. Condition class is defined in Table 3 above.

Desired Condition

The entire project is within the WUI, therefore the desired condition is outlined in the 2004 Framework which is stated below

Desired Conditions within defense zone

- Stands in defense zones are fairly open and dominated primarily by larger, fire tolerant trees
- The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire and when effectively treated provide a safer place to protect structures in adjacent lands.
- Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely
 - Ladder fuels are the vegetative fuel (small trees and shrubs) which provide vertical continuity between the ground surface and the forest canopy
 - Surface fuels are the vegetative fuel on or near the ground surface, consisting of leaf and needle litter, grass, dead branch material, downed logs, bark, pine cones and low growing vegetation

Desired Conditions within threat zone

- Flame lengths at the head of the fire are less than 4 feet under 90th percentile weather conditions
- Rate of spread at the head of the fire is reduced to at least 50 percent of pre-treatment levels under 90th percentile weather conditions
- Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control of prescribed fire and fire suppression consistent with safe practices guidelines
- Production rates for fire line construction are doubled from pre-treatment level

V. Alternatives Analyzed in Detail

Alternative 1—Proposed Action

The Big Jack East Proposed Action proposes to treat approximately 2,059 acres to meet the needs detailed above. The Proposed Action is composed of two management actions: defense zone treatments designed to meet Forest Plan management direction for the wildland urban intermix (WUI) defense zone, and threat zone treatments designed to meet Forest Plan management direction for the WUI threat zone. The 'Defense and Threat Zone Actions' section below outlines the management direction and the proposed treatments for each zone. The 'Implementation Tools' section details the technical methods that would be used to complete the treatments. The treatment and method proposal for each unit is summarized on Table 1 and is shown on Map 1. Throughout the BJE project area, particular protocols would apply to all treatments and methods. These are summarized in the 'General Vegetation and Surface Fuel Treatment Protocol' section.

The Forest Service recognizes that the proposed actions described in this document would pose a temporary disruption to adjacent residents and users of the Big Jack East area. Temporary trail closures, equipment noise, decreased visual screening, dust and smoke are some of the potential short-term effects and inconveniences. The Truckee Ranger District is very aware of these concerns and will attempt to reduce any negative impacts as much as feasible. Restrictions on work hours and days, minimizing trail closures, prioritizing work in specific areas and keeping the public informed are some of the ways the Forest Service is proposing to reduce the impact to the local community. These and other Resource Protection Measures are listed in Appendix B.

The Proposed Action is comprised of two treatment zones within the Big Jack East project area: Defense zone treatment on 558 acres and threat zone treatment on 1,501 acres for a total of 2,059 acres. The following activities are proposed:

- Use of mechanical tools to implement treatments including mechanical thinning, grapple piling, and mastication totaling 1,816 acres
- Use of hand tools to implement thinning treatments totaling 108 acres
- Created openings (COs) on 52 acres
- Tree enhancements (TEs) on 15 acres
- Leave areas (LAs) retained on 68 acres
- Pile residual activity fuels and some naturally occurring surface fuels into burn piles by hand or machine inside treatment units, or move fuels to landings to be piled and burned, or removed as biomass
- Jackpot burn or underburn would be analyzed for on all treatment areas; however, it is likely that only a portion of the project would receive these treatments
- Construct or re-open 0.5 miles of temporary roads. Temporary roads would be decommissioned following completion of vegetation management activities. Existing roads would be used wherever practicable.

Table 4 illustrates that each unit would receive a combination of treatments as dictated by its location in the wildland urban intermix zone. Details about the defense zone or threat zone treatments are available in the 'Defense and Threat Zone Actions' section below. Unit actions in the threat zone may

include a suite of smaller-scale treatments; these proposed acreages are shown in the threat zone treatment columns of this table. The vegetation management and surface fuel management tools proposed to implement the treatments for each unit are shown below and described in the 'Implementation Tools' section below. All treatment units would be evaluated for the use of underburning.

Table 4 Proposed Action Summary by Unit

Unit Number	Total Unit Acres	Defense or Threat zone Treatment	Zone Acres	Vegetation Management Tools	Surface Fuel Management Tools	Variable Density Thin Acres	Tree Enhancement Acres	Create Opening Acres	Leave Area Acres
15	4.3	Defense Zone	4.3	Hand Thin	Pile Burn – With Restrictions	N/A			
		Threat Zone	0.0	N/A					
16	52.0	Defense Zone	48.1	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	3.9	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	3.6	0.0	0.0	0.3
17	16.4	Defense Zone	16.4	Hand Thin	Pile Burn – With Restrictions	N/A			
		Threat Zone	0.0	N/A					
18	19.5	Defense Zone	1.3	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	18.2	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	18.2	0.0	0.0	0.0
19	165.2	Defense Zone	127.4	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	37.8	Mechanical Removal and Mastication	Landing Pile Burn or Remove, Pile Burn	33.5	0.5	1.4	2.4

Unit Number	Total Unit Acres	Defense or Threat zone Treatment	Zone Acres	Vegetation Management Tools	Surface Fuel Management Tools	Variable Density Thin Acres	Tree Enhancement Acres	Create Opening Acres	Leave Area Acres
				or Grapple Pile					
20	27.1	Defense Zone	0.0	N/A					
		Threat Zone	27.1	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	25.6	0.0	0.0	1.5
21	27.1	Defense Zone	0.0	N/A	N/A	N/A			
		Threat Zone	27.1	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	27.1	0.0	0.0	0.0
22	197.4	Defense Zone	0.7	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	196.7	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	181.0	1.2	3.4	11.1
22a	103.4	Defense Zone	0.0	N/A	N/A	N/A			
		Threat Zone	103.4	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	94.1	1.2	3.3	4.5
23	28.5	Defense Zone	28.5	Mastication or Grapple Pile	Pile Burn	N/A			
		Threat Zone	0.0	N/A					
24	28.5	Defense Zone	0.0	N/A					
		Threat Zone	28.5	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	27.4	0.0	0.0	1.1
25	37.2	Defense Zone	35.0	Mastication or Grapple Pile	Pile Burn	N/A			

Unit Number	Total Unit Acres	Defense or Threat zone Treatment	Zone Acres	Vegetation Management Tools	Surface Fuel Management Tools	Variable Density Thin Acres	Tree Enhancement Acres	Create Opening Acres	Leave Area Acres
		Threat Zone	2.2	Mastication or Grapple Pile	Pile Burn	2.2	0.0	0.0	0.0
26	36.9	Defense Zone	0.0	N/A					
		Threat Zone	36.9	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	36.9	0.0	0.0	0.0
27	62.0	Defense Zone	0.0	N/A					
		Threat Zone	62.0	Hand Thin	Pile Burn – With Restrictions	62.0	0.0	0.0	0.0
28	53.2	Defense Zone	31.6	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	21.6	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	18.3	0.0	1.4	1.9
29	137.9	Defense Zone	44.2	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	93.7	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	81.6	1.4	2.9	7.7
30	40.3	Defense Zone	38.3	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	2.0	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	2.0	0.0	0.0	0.0
31	14.1	Defense Zone	0.0	N/A					

Unit Number	Total Unit Acres	Defense or Threat zone Treatment	Zone Acres	Vegetation Management Tools	Surface Fuel Management Tools	Variable Density Thin Acres	Tree Enhancement Acres	Create Opening Acres	Leave Area Acres
		Threat Zone	14.1	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	14.1	0.0	0.0	0.0
32	30.9	Defense Zone	10.4	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	20.5	Biomass Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	20.1	0.0	0.0	0.4
33	180.4	Defense Zone	0.0	N/A					
		Threat Zone	180.4	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	163.5	4.0	7.4	5.5
34	236.5	Defense Zone	71.0	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	165.5	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	145.5	1.9	10.3	7.8
35	130.6	Defense Zone	51.1	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	79.5	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	73.2	0.2	1.2	4.9
36	164.6	Defense Zone	0.0	N/A					
		Threat Zone	164.6	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	146.5	1.7	7.6	8.8

Unit Number	Total Unit Acres	Defense or Threat zone Treatment	Zone Acres	Vegetation Management Tools	Surface Fuel Management Tools	Variable Density Thin Acres	Tree Enhancement Acres	Create Opening Acres	Leave Area Acres
37	239.7	Defense Zone	45.2	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	N/A			
		Threat Zone	194.5	Mechanical Removal and Mastication or Grapple Pile	Landing Pile Burn or Remove, Pile Burn	168.5	3.1	12.6	10.2
49	3.5	Defense Zone	3.5	Hand Thin	Pile Burn – With Restrictions	N/A			
		Threat Zone	0.0	N/A					
50	20.6	Defense Zone	0.0	N/A					
		Threat Zone	20.6	Hand Thin	Pile Burn – With Restrictions	20.6	0.0	0.0	0.0
52	1.1	Defense Zone	1.1	Hand Thin	Pile Burn – With Restrictions	N/A			
		Threat Zone	0.0	N/A					
Totals	2059.2				Totals		15.4	51.6	68.3

General Vegetation and Surface Fuel Treatment Protocol

The following list presents key vegetation and surface fuels treatment protocols that would be applied to all treatment units in both the defense and threat zone as applicable. This list is not all-encompassing and is intended to highlight protective elements or design measures that guide action in each unit. Site specific details for the defense and threat zones are presented in the ‘Defense and Threat Zone Actions’ section below. Detailed descriptions of the tools/methods to be used are presented in the ‘Implementation Tools’ section below. Resource protection measures that pertain to actions throughout the entire project area are presented in Appendix B: Resource Protection Measures.

- Vegetation up to 10.9 inches diameter breast height (dbh), generally referred to as biomass, would be removed as needed to achieve desired WUI conditions.
- Trees between 10 inches dbh up to 30 dbh would be removed as needed to meet desired WUI conditions.
- Live conifer trees 30 inches dbh and larger would be retained. Exceptions to this standard would be allowed for equipment operability and trees that pose a hazard as defined by *Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region*.

- Whenever feasible, treated material would be removed off-site as saw logs, biomass, fuelwood, or other forest products.
- As needed to meet desired WUI conditions, a secondary treatment (biomass removal, grapple pile, or mastication) would follow the initial mechanical treatment as soon as practicable. The intent is to complete the secondary treatment within the same year or within one year after the initial treatment is complete. Initial treatment and secondary treatment can occur concurrently if the contractor has the right equipment. However, circumstances may occur where contractors could be pulled away from projects to do emergency work on wildfires or other natural disasters which is out of our control. Therefore it is difficult to put time constraints on completion of work. Surface fuel treatments such as pile burning could take up to five years after the piles are made.
- Underburning is being proposed and analyzed for on the entire project area and could take up to 10 years to complete; however, it is unlikely that all of the project area would receive this treatment. Underburning is difficult due to the small window of opportunity due to weather, air quality concerns and other constraints.
- The existing 300-foot wide fuel break along the 06 Road, also known as the Sawtooth Road, would be reestablished and maintained using management direction for WUI defense zone treatments to provide a safe area for firefighters to engage a wildfire and protect the community of Truckee.
- Healthy sugar pine trees showing no indication of white pine blister rust disease would be retained during mechanical removal, except as necessary to promote overall health and resilience of a sugar pine group.
- Mechanical tree removal and fuels treatment equipment may operate on slopes up to 30 percent, however short pitches up to 200 feet long and up to 35 percent slope could be included in mechanical treatments. Treatment on steeper slopes would use non-mechanical methods that avoid ground disturbance.

Defense and Threat Zone Actions

The entire BJE project is within wildland urban intermix defense or threat zone as defined in the Tahoe National Forest Land and Resource Management Plan (1990), as amended by the Sierra Nevada Forest Plan Amendment Record of Decision (2004), collectively referred to as the Forest Plan. The following sections describe Forest Plan management direction for treatments in these zones, and detail the site-specific treatments that have been designed to meet this direction.

Key differences between the desired conditions in the two zones are as follows:

- The defense zone should be fairly open and dominated by larger, fire tolerant trees. Defense zones should be treated to reduce wildland fire spread and intensity to allow suppression efforts to succeed.
- While both the defense and threat zones are primarily focused on reducing wildland fire spread and intensity and treating hazardous fuels, additional treatments in the threat zone can incorporate variability with features that benefit other resources such as wildlife, forest health and insect and disease resilience.

Each unit to be treated by the Proposed Action (shown on Table 1 and Map 1) would receive one of, or a combination of, the treatments described below. Following implementation of a vegetation treatment,

areas may also receive surface fuel and prescribed fire treatments to meet desired conditions described in the respective zone management direction sections below.

Defense Zone Description

The wildland urban intermix zone (WUI) is an area where human habitation is mixed with areas of flammable wildland vegetation. It extends out from the edge of developed private land into Federal, private, and State jurisdictions. The WUI is comprised of two zones: the defense zone and the threat zone.

The WUI defense zone is the buffer in closest proximity to communities, areas with higher densities of residences, commercial buildings, and/or administrative sites with facilities. Defense zones generally extend roughly ¼ mile out from these areas; however, actual defense zone boundaries are determined at the project level following national, regional and forest policy. In particular, the Healthy Forest Restoration Act of 2003 identifies areas to be included in the WUI. Local fire management specialists determine the extent, treatment orientation, and prescriptions for the WUI based on historical fire spread and intensity, historical weather patterns, topography, access. Defense zones should be of sufficient extent that fuel treatments within them will reduce wildland fire spread and intensity sufficiently for suppression forces to succeed in protecting human life and property. (SNFPA ROD, pg. 40).

Management Direction for Defense Zones

Desired Conditions

- Stands in defense zones are fairly open and dominated primarily by larger, fire tolerant trees
- The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire and when effectively treated provide a safer place to protect structures in adjacent lands.
- Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely
 - Ladder fuels are the vegetative fuel (small trees and shrubs) which provide vertical continuity between the ground surface and the forest canopy
 - Surface fuels are the vegetative fuel on or near the ground surface, consisting of leaf and needle litter, grass, dead branch material, downed logs, bark, pine cones and low growing vegetation

Management Intent

- Protect communities from wildfire and prevent the loss of life and property
- Defense zones have highest priority for treatment

Management Objectives

- Create defensible space near communities, and provide a safe and effective area for suppressing fire
- Design economically efficient treatments to reduce hazardous fuels

Defense Zone Treatments

Vegetation and fuels management treatments within the defense zone would be designed as follows. A fuel break, approximately ¼-mile wide, would be created or maintained along the northern and eastern private property boundaries of the project area using the following defense zone treatment parameters. The exact boundary is determined by fuels professionals and based on aspect, terrain, and basal conditions. The ¼ mile fuel break was determined to be sufficient by the district fuels and fire staff as well as following guidelines from the 2004 Forest Plan. The defense zone treatment would remove ladder fuels, surface fuels and space residual trees to provide crown separation and improve the health and vigor of these stands using thinning or other vegetation management tools.

Within the Mechanical Removal units, trees less than 29.9" DBH would be removed until the desired crown spacing is reached to meet fuels management goals. Trees should be spaced so the canopy of the larger trees would not support a sustained crown fire. Ladder fuels would be removed to keep fire from reaching the crowns of the larger trees. Post-treatment basal areas are anticipated to be approximately 80 to 100 ft² per acre. Treatment would retain the healthiest trees in the following order of priority, based primarily on shade tolerance and fire resistance: sugar pine, ponderosa pine/Jeffrey pine, lodgepole pine and white fir.

Within the Hand Thin units and trees less than 11" DBH would be removed. Spacing within these units are to be on a rough 20' by 20' spacing, allowing for variability and for fuel management goals. Treatment would retain the healthiest trees in the following order of priority, based primarily on shade tolerance and fire resistance: sugar pine, ponderosa pine/Jeffrey pine, lodgepole pine and white fir.

After the vegetation treatment, fuels management treatments would treat the residual and existing surface fuels to accomplish desired conditions and consistency with Forest Plan. The vegetation management and surface fuel management tools used to accomplish these treatments are displayed on a site-specific level in Table 4 above. The 'Implementation Tools' section below provides technical details about each tool.

Threat Zone Actions

Threat Zone Description

The WUI threat zone typically buffers the defense zone; however, a threat zone may be delineated in the absence of a defense zone under certain conditions, including situations where the structure density and location do not provide a reasonable opportunity for direct suppression on public land, but suppression on the private land would be enhanced by fire behavior modification on the adjacent public land.

Threat zone boundaries are determined at the project level following national, regional and forest policy. Threat zones generally extend approximately 1¼ miles out from the defense zone boundary; however, actual extents of threat zones are based on fire history, local fuel conditions, weather, topography, existing and proposed fuel treatments, and natural barriers to fire. Fuels treatments in these zones are designed to reduce wildfire spread and intensity. Strategic landscape features, such as roads, changes in fuels types, and topography may be used in delineating the physical boundary of the threat zone. (SNFPA ROD, pg. 40). Fire and fuels staff looked closely at the landscape, fire history,

weather and proposed fuel treatments and determined that 1 ¼ miles beyond the defense zone would be appropriate to meet fire and fuels objectives for this project.

While both the defense and threat zones are primarily focused on treating hazardous fuels, additional treatments in the threat zones would carefully incorporate features that benefit other resources such as wildlife, forest health and insect and disease resilience. These features are listed in Table 1 as Leave Areas, Create Openings and Tree Enhancement. These features are described in detail in the Threat Zone Treatments Section below. In addition, the thinning treatment within the threat zone (variable density thinning) would emphasize varying tree density to create the horizontal heterogeneity that is inherent to these landscapes.

Management Direction for Threat Zones

Desired Conditions

- Flame lengths at the head of the fire are less than 4 feet
- Rate of spread at the head of the fire is reduced to at least 50 percent of pre-treatment levels
- Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control of prescribed fire and fire suppression consistent with safe practices guidelines
- Production rates for fire line construction are doubled from pre-treatment level

Management Intent

- Fuels treatments in the threat zone provide a buffer between developed areas and wildlands
- Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas

Management Objectives

- Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior
- Design economically efficient treatments to reduce hazardous fuels

Forest-wide standards and guidelines for fuels treatments include direction for reducing tree density to a level consistent with the site's ability to sustain forest health during drought conditions (SNFPA ROD, pg. 49).

Threat Zone Treatments

Vegetation and fuels management treatments are designed to remove ladder fuels, surface fuels and space residual trees to provide crown separation and also improve the health and vigor of the treated stands to accomplish desired conditions and consistency with Forest Plan. Threat zone treatments would be aimed at creating a heterogeneous forest structure that would be more resilient to wildfire. Treatments in the threat zone would be consistent with Forest Plan direction for mechanical thinning in eastside pine vegetation types outside WUI defense zones (SNFPA ROD, Standards and Guidelines (S&Gs) #6 and #8, pp. 50 – 51). S&G #6 requires, "For all mechanical thinning treatments, design projects to retain all live conifers 30 inches dbh or larger. Exceptions are allowed to meet needs for

equipment operability.” S&G #8 requires, “For mechanical thinning treatments outside defense zones in the eastside pine type: in mature forest habitat (CWHR types 4M, 4D, 5M, 5D, and 6), design projects to retain 30 percent of the existing basal area. The retained basal area should be generally comprised of the largest trees. Projects in the eastside pine type have no canopy cover retention standards and guidelines.”

The vegetation and surface fuel management tools proposed to accomplish these treatments are displayed on a site-specific level in Table 1 above. The ‘Implementation Tools’ section below provides technical details about each tool. The vegetation treatments designed achieve desired conditions within the threat zone are described below.

Variable Density Thinning

This prescription is highly site-specific, and set within the context of the existing stand’s structure and tree species composition. In general, variable thinning involves selective removal and retention of individual codominant and subdominant trees and/or small groups of codominant and subdominant trees.

As stated above, trees up to 29.9 inch dbh could be removed according to a variable density prescription designed to increase forest heterogeneity, while also meeting fuels management objectives. On-the-ground decisions about which individual trees and groups of trees to retain are made in light of (1) ensuring overall stand structure remains intact following application of prescribed fire and (2) developing stand structures that trend towards reference conditions developed under active fire regimes and (3) achieving stand conditions that are consistent with the Forest Plan management direction for the threat zone allocation.

The following excerpt from Knapp et al. (2017) provides background about the ecological foundation of this prescription. See EA Appendix F for this reference and others). “Early observers in unharvested or “virgin” forests associated with frequent fire consistently noted that trees were grouped or clustered, as opposed to regularly spaced (Dunning, 1923; Cooper, 1961), and uneven aged, or “at best even-aged by small groups” (Show and Kotok, 1924). Historical data and stand reconstructions indicate that conifer-dominated forests throughout the western US appear to have shared a similar structure, with widely spaced individual trees, groups of trees, and canopy openings organized at 0.1–0.3 ha spatial scales (Larson and Churchill, 2012). This “patchy and broken” structure contributed to the relative immunity of historical forests to crown fire (Show and Kotok, 1924). Because surface fuels are a product of overstory structure and composition (Lydersen et al., 2015), variability in overstory conditions presumably led to surface fuel discontinuity, which likely limited spread of higher intensity fire (Miller and Urban, 2000). Given the environmental stress forest ecosystems are likely to experience under a changing climate, heterogeneity may be particularly important in shaping stand resilience to wildfire and other disturbances (Drever et al., 2006; Stephens et al., 2010).”

Variable thinning would be applied using the following guidelines:

- Generally favor retention of pines over firs, especially in southerly facing areas and on ridges. Retained groups of larger trees (described under the bullet below) may include fir trees. Overall

the emphasis for retained groups of trees is preserving or enhancing desirable stand structure rather than managing for any particular species composition.

- Retain groups of larger trees, generally comprised of five to ten (or more) trees of roughly similar size. Ideally, some of the retained trees should have desirable habitat features, such as forked or broken tops. Remove trees adjacent to these retained groups to improve the overall health and resiliency of the group to drought, insects and disease.
- Where a few (less than five) trees occur together, or where trees are scattered, retain the more vigorous trees by removing subdominant and, in some cases, co-dominant trees around them to reduce ladder fuels and competition for light, water, and nutrients.
- In areas of greater white fir dominance where large trees tend to grow in more of a clumped nature, emphasize retaining clumps or groups of generally five to ten trees and removing trees adjacent to these retained clumps to create small, variably shaped gaps.
- When making site-specific determinations on individual tree removal/retention preferences, vary the choices made so as to increase the variability at the micro-site scale.
- Variable thinning would not be applied in leave areas, create opening areas, adjacent to trails, powerlines or fuel break maintenance areas.

Early observers in unharvested or “virgin” forests associated with frequent fire consistently noted that trees were grouped or clustered, as opposed to regularly spaced (Dunning, 1923; Cooper, 1961), and uneven aged, or “at best even-aged by small groups” (Show and Kotok, 1924). Historical data and stand reconstructions indicate that conifer-dominated forests throughout the western US appear to have shared a similar structure, with widely spaced individual trees, groups of trees, and canopy openings organized at 0.1–0.3 ha spatial scales (Larson and Churchill, 2012). This “patchy and broken” structure contributed to the relative immunity of historical forests to crown fire (Show and Kotok, 1924). Because surface fuels are a product of overstory structure and composition (Lydersen et al., 2015), variability in overstory conditions presumably led to surface fuel discontinuity, which likely limited spread of higher intensity fire (Miller and Urban, 2000). Given the environmental stress forest ecosystems are likely to experience under a changing climate, heterogeneity may be particularly important in shaping stand resilience to wildfire and other disturbances (Drever et al., 2006; Stephens et al., 2010)

Leave Areas (LA)

LAs are small existing areas, ranging in size from 0.1-2.25 acres, within treatment units that provide continuous vertical and horizontal cover. Areas designated as LAs may contain multiple wildlife habitat elements such as: large down woody material, a mixture of tree age classes (including solitary and groups of large trees), large snags, multiple tree canopy layers, and/or trees with features associated with wildlife use (for example, platforms, mistletoe brooms, forked tops, and cavities). LAs would contribute to/enhance within-stand horizontal and vertical structural diversity and provide important old forest and/or mid-seral habitat elements. Designated LAs may represent multiple layered late-seral conditions with high levels of decadence and dead wood, or they may represent a mid-seral condition with shrub and a medium sized tree overstory that provide important movement, hiding, and resting cover for wildlife. It is important to note that LAs would not be retained in the defense zone. No mechanical tree removal would be conducted in LAs.

Prescribed fire over the long term could be an important management tool within LAs, although only one entry would occur with this project. For LAs comprised of multiple sizes of trees, snags, and down wood, prescribed fire would be carefully applied to maintain key habitat elements, particularly snags

and down wood. While underburning in LAs would likely result in some mortality of suppressed and subdominant trees, burning prescriptions would be designed and implemented to retain the overall structure of the LAs.

Create Openings (CO)

COs would be small areas, ranging in size from 0.1-1.25 acres, where all trees under 29.9 inches dbh would be removed. Typically these areas are comprised of existing clumps of dense, younger, and smaller diameter trees. In some cases, COs may include pockets of larger diameter trees in the 24.0-29.9" dbh range. Other COs are in areas as of sparse tree cover, thinner soils, or pockets of tree mortality. The removal of vegetation from COs would provide early-seral conditions, providing foraging habitat for old forest associated wildlife species, and enhance within-stand age and species diversity. Revegetation of the COs would add to the diversification of the BJE areas within the threat zone. Based on site conditions and on-the-ground evaluations, revegetation would occur 1) by planting a variety of tree species; 2) by planting a different genetic strain of tree species already on site; or 3) naturally by local shrub and tree seed sources, or a combination thereof. It is important to note that COs would not be created in the defense zone.

If an area exhibiting insect or disease mortality is identified in close proximity to a location planned for the create opening prescription, the interdisciplinary team may evaluate the potential to shift the CO prescription to the new area of mortality while maintaining the CO size and general location as well as the overall acreage of planned COs within the treatment unit. Implementation of the CO prescription would be flexible in order to respond to changed conditions, but could be shifted only after interdisciplinary team review and Responsible Official approval.

Prescribed fire over the long term could be an important management tool within COs, although only one entry would occur with this project. Within COs, prescribed fire would be applied to regenerate shrubs and create suitable areas for shade-intolerant tree species to regenerate.

Tree Enhancements (TE)

Tree enhancement thinning is different from variable density thinning in that tree enhancement thinning focuses specific attention on an individual isolated tree, whereas variable density thinning takes in account a larger stand-scale approach. An isolated tree is typically (but not always, as described below) a larger tree (greater than 24 inches dbh) and defined by being located at least 20 feet (6 meters) away from the bole of any neighboring tree and no more than 50 feet (15 meters) from the bole of any neighboring tree (Churchill et al. 2013). Under tree enhancement thinning, the radial distance of treatment around isolated trees would be variable and based on site-specific conditions. Generally treatment distances would be 30 feet from the bole of the tree, with a minimum treatment distance of 20 feet and a maximum of 50 feet on steeper slopes. Larger distances are needed on the downhill side of isolated trees in order to compensate for the longer flame lengths due to slope. Within the radial thinning distance of an isolated tree, all trees less than 24 inches dbh would be removed. Removal of these trees would result in increased root and diameter growth while also improving overall health and resiliency of a targeted tree. In addition, the removal of understory trees removes ladder fuels which minimizes the risk that fire could carry into the canopy of the isolated tree.

The goal of tree enhancement thinning treatment is to manage for and protect specific individual isolated trees with the intent that these individual trees will become the well-established, open grown and resilient trees of the future. Overall, these carefully selected trees tend to be larger, typically greater than 24 inches dbh, and at least a generation older than trees in the surrounding area. However, other trees have been identified for tree enhancement thinning due to their potential to become well

established, resilient trees in the future. Many of these trees have become overgrown and crowded by younger, shade tolerant trees. Treatment is designed to increase the resiliency of the selected trees by isolating them from the effects of fire, drought, insects, and disease while also maximizing the potential for diameter and height growth by removing adjacent competing trees.

Isolated trees tend to be the most resilient trees on the landscape, thus, they have the most potential to become large and will usually do so in the shortest amount of time. When these trees do die, they become the largest dead wood components on the landscape and remain on the landscape as structure for the longest period of time adding to the diversity of habitat on the landscape. The ratio of isolated trees to clumps of trees, LAs, and COs would fluctuate by topographic position on the landscape. In a study of frequent-fire pine and mixed conifer forests in western North America, isolated trees accounted for 32% of the total trees with 51% of the basal area in reference plots that experienced active fire (Churchill et al. 2013). Isolated trees could possibly compose as much as 30% of the stand's trees.

Implementation Tools

The following vegetation and fuels management tools would be used for treatment implementation throughout the project area. Table 4 displays the tools proposed to be used for each unit.

Mechanical Removal

In this document the term “mechanical removal” is used to describe the tools in which selected conifer trees ranging in size from 10.0 inches dbh to 29.9 inches dbh would be removed from the forest. For the BJE project there are two methods of mechanical removal being proposed: traditional mechanical harvest and cut-to-length harvest. Conifer trees up to 10.9 inch dbh may also be removed as biomass during mechanical removal operations. Following the initial mechanical removal, treated areas would have a follow-up surface fuels treatment that would continue to move the harvested areas towards the desired conditions for the respective defense and threat zones.

- **Traditional mechanical harvest**, also known as “whole tree yarding”, is a ground based operation that cuts the trees designated for removal using a tracked mechanized piece of equipment called a feller buncher. The trees, placed in bundles by the feller buncher, are transported by skidders to the roadside landing with tops and limbs still attached. Skidders, either rubber tired or tracked, work on a network of approved skid trails that fan out from the designated landing. Once the trees are at the landing, they are delimbed, topped, and processed into sawlogs for removal by log truck. After the initial mechanical harvest and sawlog removal, remaining biomass material on the landings would be treated by the Landing Pile Burn or Remove Tool (described below)
- **Cut-to-length** is a ground based operation that cuts trees designated for removal using a rubber tired mechanized piece of equipment called a processor. The processor completes the felling, delimbing, and bucking at the stump area, leaving limbs and tops in the forest. The processor decks the logs throughout the harvest area on a network of approved forwarder trails. Following the decking and processing of logs in the forest, a second piece of rubber tired equipment called a forwarder gathers the processed logs and transports them to the roadside for removal by log truck. Chip and remove would also be an option, but currently options for removal are limited. Generally after sawlog removal with cut-to-length operations there are no significant amounts of biomass requiring treatment remaining on the landings. See descriptions of Surface Fuel Management Tools below.

With both mechanical treatments there is an inherent hand treatment component. For example, hand falling with a chainsaw may be required for trees exceeding the capabilities of the feller buncher or processor. Generally these pieces of equipment are capable of falling trees up to 22 inches at the stump. Hand falling may also be required for resource protection in other areas such as stream buffer zones or other sensitive areas.

Biomass Removal

In this document the term “Biomass Removal” refers to the removal of conifer trees up to 10.9 inches dbh. Biomass removal uses the same or similar equipment as mechanical removal of larger trees. Often biomass removal occurs concurrently with mechanical removal. In areas without mechanical removal of larger trees, biomass removal may be implemented as the initial treatment. The biomass is either chipped and removed or brought to a landing to burn. Biomass material brought to the landings would be treated by the Landing Pile Burn or Remove Tool described below.

Mastication

Mastication is the rearranging of woody biomass material, smaller trees up to 9.9 inches dbh, shrub, and downed woody material on site. It is a ground based operation that uses a tracked or wheeled mechanized piece of equipment called a masticator to “chew” up the biomass on site. Mastication does not actually remove fuels from the treated area, but changes the size, continuity, and arrangement of the fuels, leading to an acceleration of decomposition rates of processed material and producing a desired change in fire behavior by reducing the amount of oxygen within the fuel structure. For example, a standing tree, or vertical fuel, is chewed up or rearranged into many smaller pieces of horizontal fuel. Mastication may be a follow-up treatment to mechanical removal, or it may be the initial tool used in an area. After mastication operations, remaining surface fuels within each harvest unit would be assessed. If necessary to meet the desired conditions of the defense and threat zones an additional surface fuels treatment, such as jackpot burning or underburning, would be applied.

Grapple Pile

Grapple piling is a ground based operation that uses a tracked or wheeled mechanized piece of equipment to lift and/or gather woody biomass material into piles for burning at a later date. One method of grapple piling uses the machinery to “lift” the living vegetation (small trees and shrubs) out of the ground (including roots) and then gathers the material into grapple piles. Pulling shrubs and other vegetation by the roots stops vegetation from re-sprouting. Grapple piles may also include existing dead and downed woody surface fuels. Another manner of grapple piling is completed by hand cutting of vegetation (small trees and shrubs) with chainsaws and then using a tracked or wheeled mechanized piece of equipment to gather this cut material into grapple piles. Small trees (up to 9.9 inches dbh) would be treated with grapple piling. Grapple piling may be a follow-up treatment to mechanical removal, or it may be the initial tool used in an area. Piles created by grapple piling would predominantly be burned as described in the Pile Burn (Grapple or Hand) section below. There is a limited chance that material from grapple piles would be removed (as described in the Landing Pile Burn or Removal section below) versus burned in piles, and removal would remain an option throughout implementation.

Piling fuels can be an effective treatment for reducing and removing the amount of surface fuels, breaking up the horizontal continuity of surface fuels across a landscape and increasing the separation between surface and canopy fuels. Burning the piles to remove and reduce the amount of fuels in a stand or across a landscape makes the reintroduction of low-intensity fire by underburning more feasible. There are increased prescribed burning opportunities for the burning of piled material because there is a larger timeframe or burn window available. Grapple piles take a full season to cure before

they can be burned and they will not be burned until fall/winter months. Therefore piles will sit for two seasons before they are conducive to burning. After that it will depend on weather and resource availability before they can be burned.

Hand Thin

Hand thinning is a method used to remove conifers up to 10.9 inches dbh in places where access with mechanical removal equipment is not possible or appropriate. Trees are felled and cut into smaller lengths by individuals using chainsaws. Mostly, the cut trees would be hand piled for burning at a later date when material has cured and would burn more effectively and with less smoke generated. In some areas, where accessible and within 100-200 feet from a road, the small tree bole material could be left in place or moved to the roadside for utilization by the public for fuelwood. Limbs in these areas would be piled for burning. There are also hand thin areas where hand piling would not be conducted for resource protection. In these areas, cut material would be transported out of the protected area in a manner that would not disturb the ground cover, then piled or removed. Options for chipping and/or removal of hand thinned material are limited, but would be considered during implementation if the opportunity arises.

Chipping

Chipping is a mechanical operation that takes biomass material and “chews” it into smaller pieces. Chipping may occur at landings, along roadsides or within units. Chipping within a unit has several limitations such as accessibility, material size and desired residual fuel loading. Chips created within a unit may be removed or distributed back into the unit to a depth no greater than 4 inches. Material chipped on a landing is generally removed, but chips may also be distributed on and adjacent to the landing to a depth no greater than 4 inches. Chipping and removal options are very limited at this time. Opportunities for chipping and distributing chips throughout the unit are also limited, but both of these options would be considered during implementation whenever feasible.

Pile Burn (Grapple or Hand)

Residual activity fuels and some naturally occurring fuels would be piled into burn piles by hand or machine, as described above. Pile burning within treatment units is designed to remove surface fuels generated from treatments and existing fuels on the ground. Pile location and size is dictated by existing conditions; however, piles would be preferentially placed outside of sensitive areas such as riparian conservation areas and cultural resource sites. In areas denoted with piling restrictions due to resource protection needs, material would be transported outside of the denoted area in a manner that does not disturb the ground cover, and piled and burned. Piles are typically burned under fall-like conditions, in winter months, or during periods of low fire danger. These conditions help to minimize the amount of mortality of remaining vegetation. There are increased prescribed burning opportunities for the burning of piled material because there is a larger timeframe or “burn window” available. Pile burning can take place in the snow where underburning cannot. Piles take a full season to cure before they can be burned and they would not be burned until fall/winter months. Therefore piles would remain on site for two seasons before they would be conducive to burning. After that, it would depend on weather and resource availability before they could be burned.

Underburn

The entire project area would be analyzed for underburning; however, it is likely that only a portion of the project would receive this treatment. Underburning is usually the last treatment in a series of treatments, or it can be used as a stand-alone treatment or a maintenance treatment. After initial vegetation treatment is completed it may be determined that a unit will not need an underburn treatment. However, there may be other areas that would need a maintenance treatment which means

that an area may be burned more than once over the course of many years. Underburning actions would adhere to the resource protection measures detailed in Appendix B. Not restricting underburning to vegetation treatment unit boundaries would allow for the use of logical and natural control lines for implementation.

An underburn is a prescribed fire ignited under the forest canopy that focuses on the consumption of surface fuels, but not the overstory vegetation. Underburns are ignited using small strips of fire to burn with low to moderate intensity to mimic a wildfire under controlled conditions in order to reduce downed woody debris, needles and duff, while removing small areas of shrubs and occasional pockets of trees. Widening or narrowing the width between strips increases or decreases fire intensity. Underburning requires the use of firelines to contain the prescribed fire within the targeted areas. Firelines are linear features that are cleared of vegetation and fuels down to mineral soil. Firelines are typically two to three feet wide when constructed by hand, however they can be up to four feet wide when created by small machinery. Existing natural openings, roads or trails are effective firelines and are used whenever possible in lieu of handline construction. The determination of size of underburn units is based on areas that can be easily managed with available resources. Another consideration for the size of an underburn unit is smoke dispersion forecasts. An underburn is the most practical way to reduce accumulations of surface fuels in this project area. However, it is also the most difficult due to the small window of opportunity due to the short burn window for these types of operations. Underburning has been difficult to accomplish in the past.

Jackpot Burn

Jackpot burning is a modified underburn that addresses high concentrations of naturally-occurring or thinning-related downed woody debris that is not piled. Different than underburning because in lieu of strip ignition, jackpot burning involves igniting concentrations, or “jackpots”, of vegetative fuels on the forest floor. The result of jackpot burning is a mosaic pattern of vegetative fuel consumption. This technique works well when surface fuels loading is very high following vegetation treatments.

Landing Pile Burn or Removal

After traditional mechanical removal, biomass material (limbs, tops, small trees and defect material) remains on the landing from operations. This material would be decked or piled for burning. Landing piles are generally larger than grapple piles and may burn for longer periods of time. There is the possibility of multiple landing piles on each landing. To facilitate faster burning, efforts would be made to create more, smaller landing piles on the landings versus one large landing pile. With cut-to-length operations, generally there is no significant biomass material left on the landings that requires burning or removal. If the rare occasion did occur, the small amount of material would be piled for burning or removed.

The preferred treatment of the biomass material remaining on the landings would be to remove as firewood, chips or other biomass product, but removal is greatly dependent on the commercial biomass market at the time of implementation. Currently options for removal are limited, but options will be monitored throughout the implementation of the project and when feasible removal will be implemented.

Alternative 2—No-Action Alternative

Under the no action alternative there would be no new proposed treatments within the project area.

VI. Methodology

The following sections discuss the scope of analysis, methodology, and indicators to describe the affected environment and assess the environmental consequences of the proposed action on fire and fuels. It will also assess the design features to reduce the impacts of action alternatives, and develop a monitoring plan to ensure that forest standards and guidelines are met to maintain fire and fuels objectives. Indicators that will be evaluated are fire type (surface fire, active crown fire, and passive crown fire), rate of spread, flame length and firefighter production rates

“All models are wrong but some are useful” – George Box, 1979

Weather and fuel moisture data was obtained for the Stampede Remote Area Weather Station (RAWS). This data was accessed from an online database, and analyzed using FireFamilyPlus software to derive 90th percentile weather conditions for the specific parameters needed for modeling. FireFamilyPlus (FFP) is a comprehensive Windows-based program that analyzes and summarizes an integrated database of fire weather and fire occurrence. FFP can be used to calculate fire danger rating indices and components, summarize both fire and weather data, and offers options to jointly analyze fire and weather data. More information is available on the FireFamilyPlus website:

<https://www.firelab.org/project/firefamilyplus>

The 90th percentile weather or average worst weather conditions will be used to represent the specific weather factors for planning purposes. This means that only 10% of the observed weather days for the past 10 years have had more severe fire weather than those used for determining fire intensity levels. (Tahoe National Forest Land and Resource Management Plan 1990).

Table 5 displays 90th percentile weather conditions for the National Fire Danger Rating System (NFDRS) weather station at Stampede RAWS which was used to inform the Behave modeling runs performed in the Big Jack East Project Area.

Table 5 90th percentile weather for Stampede Weather Station, Tahoe National Forest, California

Maximum Dry Bulb (F)	82
Minimum Relative Humidity (%)	10
Maximum Wind Speed – 20'	17
1-hour fuel moisture (%) (dead)	2
10-hour fuel moisture (%) (dead)	4
100-hour fuel moisture (%) (dead)	7
Live Herbaceous fuel moisture	31

Assumptions

Slope for each fuel model remained constant at 10% to represent average topography across the area. The wind reduction factor was determined using the Fire Behavior Wind Adjustment Table and is typically specific for slope position and cover type. For this assessment all models were assigned a reduction of 0.3 (partially sheltered).

Modeling Used in Analysis

The BehavePlus fire modeling system was used in this document to predict fire behavior. The system is composed of a collection of mathematical models that describe fire behavior, fire effects, and the fire environment based on specified fuel and moisture conditions. The program simulates rate of fire spread, spotting distance, scorch height, tree mortality, fuel moisture, wind adjustment factor, and many other fire behaviors and effects; it is commonly used to predict fire behavior in multiple situations.

Some applications include:

- **Predicting the behavior of an ongoing fire.** Historically, this was the original use for Behave as described by Rothermel (1983) in "How to Predict the Spread and Intensity of Forest and Range Fires. Today, the modern version of Behave, BehavePlus Version 5.0, is even more powerful for predicting fire behavior during wildfires and prescribed fires in the United States and other countries because of its expanded features and capabilities.
- **Planning fire treatments.** Contingency planning depends on complex fire variables, such as spotting distance, probability of ignition, spot fire growth, and probability of containment. All of these are modeled in BehavePlus to facilitate planning of prescribed fires for ecological restoration or fuel reduction programs.
- **Assessing fuel hazard.** Fuel moisture and wind conditions are easily manipulated in BehavePlus. Variations in these factors affect fire behavior in surface and crown fuels, so understanding the sensitivity of fuels to moisture and wind is essential to assess whether fuel accumulations have potentials to burn or whether planned treatments may be dangerous to fire fighters or the public.
- **Understanding fire behavior.** Modeling systems are excellent sources for educating and training personnel on the subtleties of fire behavior. The complex interactions among fire, fuel, moisture, and wind can be easily explored in BehavePlus by changing input variables and fuel conditions for each model run. This makes BehavePlus well suited to learning about fire behavior in safe surroundings.

Data used in modeling

In order to quantify the effects of a wildfire, a fuel model is selected to use as input to the fire spread model. A fuel model is defined by a set of fuel bed inputs needed for a particular fire behavior or fire effects model. A fuel model is chosen by the primary carrier of the fire (e.g. grass, brush, timber litter, slash) and its fuel characteristics (e.g. fuel loading, surface area to volume ratio, fuel depth, etc.). (Rothermel 1983) has a detailed discussion on fuel models and how they are used to predict the spread and intensity of forest and range fires. These fuel models are derived from the vegetation layer and can describe fire behavior based on weather and topography.

The Landfire fuel model layer was used and is the basis for the fuel model analysis (Barrett, S., N. Sugihara, R. Siemers, and H. Safford. 2004). Fuel models selected for this analysis will primarily fit into five different fuel types; Grass (GR), Grass-Shrub (GS), Shrub (SH), Timber-Understory (TU), and Timber-Litter (TL). Fuel Model descriptions are from Scott and Burgan's 2005 Standard Fire Behavior Fuel

Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model Joe H. Scott Robert E. Burgan. Table 6 displays the fuel models in terms of description, acres, and percentage of each category of fuel models within the analysis area. More information is available on the Landfire website:

<http://www.landfire.gov/>

The intent of modeling fuel treatments is to show relative changes in fire behavior between the no action and the action alternatives. The outputs are not absolutes and are bound by the assumptions and limitations of data collection methods and individual models. They do though allow for comparison of changes associated with different levels of fuel treatments.

Current Fuel Models

Table 6 describes the fuels models throughout the project area. There are four fuel models that cover the highest percentage of the project area and they are highlighted in the table below. The fuel models are derived from Landfire data and then the description comes from General Technical Report RMRS-GTR-153, June 2005, Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model. Fuel models GR1 and TL2 were less than 1 acre so they are not shown in the table. Map 7 display where each fuel model is located within the Big Jack East project.

Map 7 Big Jack East Fuel Model map, GS2, TU5, TL6 and TL9 are the most represented fuel models throughout the project

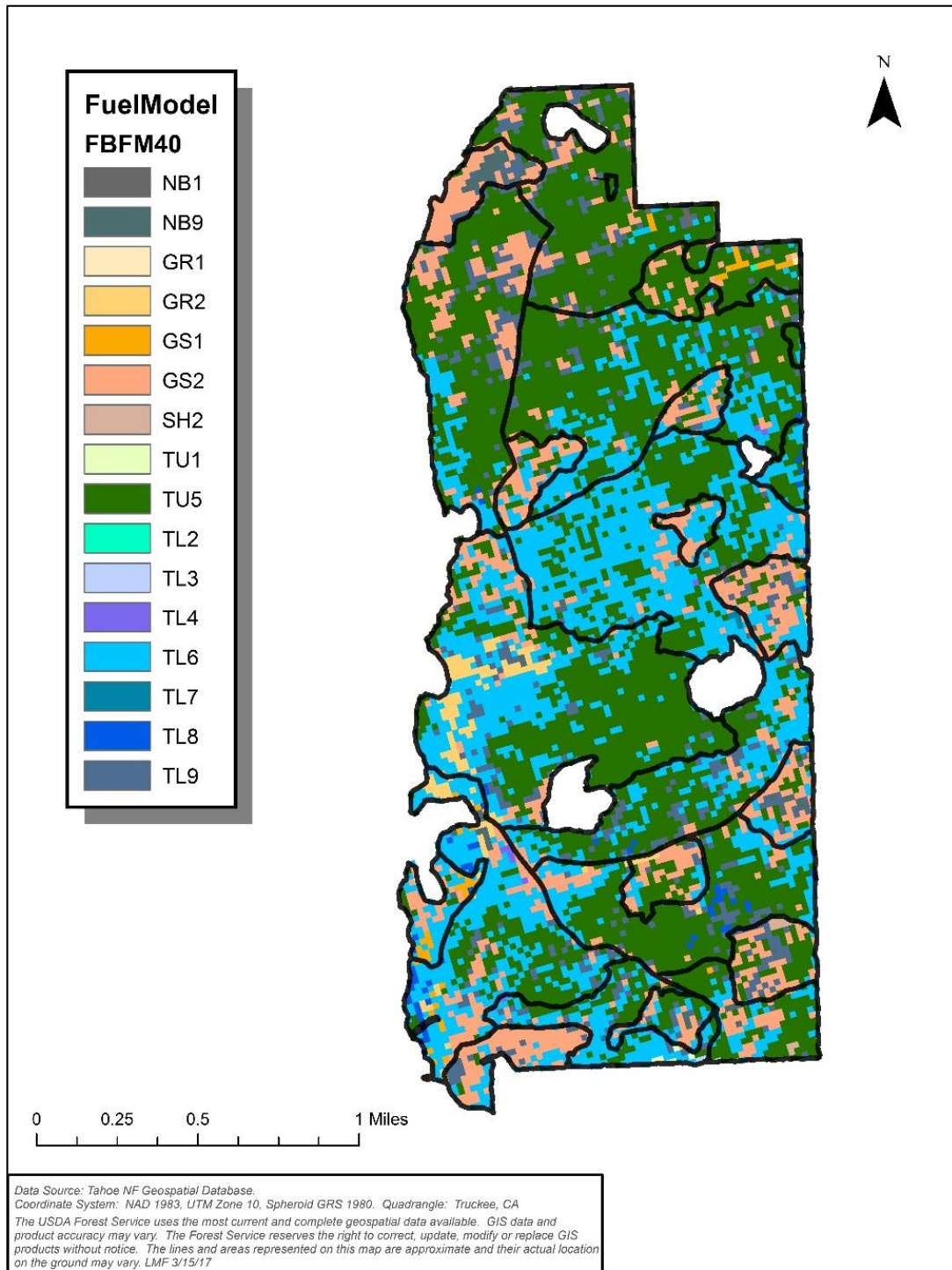


Table 6 Fuel Model Category, Description, Acres and percent of the landscape

Fuel Models throughout the entire project area	Acres within project area	Percent of project area	Flame length in feet	Rate of Spread in chains per hour	Fire Type
Unburnable areas such as rock screes, lakes, snow or ice	44	2.14%	0	0	Non Burnable
GR2 (102) Low Load, Dry Climate Grass (Dynamic). The Primary carrier of fire in GR2 is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuel bed may be more continuous. Shrubs, if present, do not affect fire behavior.	30	1.46%	7.3	79	Passive Crown Fire
GS1 (121) Low Load, Dry Climate Grass-Shrub (Dynamic). The primary carrier of fire in GS1 is grass and shrubs combined. Shrubs are about 1 foot high, grass load is low. Spread rates are moderate; flame length low. Moisture of extinction is low.	12	0.58%	5	28.8	Passive Crown Fire
GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic). The primary carrier of fire in GS2 is grass and shrubs combined. Shrubs are about 1 to 3 feet high, grass load is moderate. Spread rate is high; flame length moderate. Moisture of extinction is low. May include small trees under 3 feet.	290	14.08%	7.3	39.7	Passive Crown Fire
SH2 (142) Moderate Load, Dry Climate Shrub. The primary carrier of fire in SH2 is woody shrubs and shrub litter. Moderate fuel load depth of about 1 foot, no grass fuel present. Spread rate is low; flame length low.	3	0.15%	6.2	10.9	Passive Crown Fire
TU1 (161) Low Load Dry Climate Timber-Grass-Shrub (Dynamic). The primary carrier of fire in TU1 is low load of grass and/or shrub with litter. Spread rate is low; flame length low.	1	0.05%	2.5	4.7	Surface Fire
TU5 (165) Very High Load, Dry Climate Timber-Shrub. The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.	937	45.51%	9.7	14	Passive Crown Fire
TL3 (183) Moderate Load Conifer Litter. The primary carrier of fire in TL3 is moderate load conifer litter, light load of course fuels. Spread rate is low; flame length is low.	1	0.05%	1.4	2.7	Surface Fire

TL4 (184) Small Downed logs. The primary carrier of fire in TL4 is moderate load of fine litter and coarse fuels and includes small diameter downed logs. Spread rate is low; flame length is low.	2	0.10%	1.8	3.8	Surface Fire
*TL6 (186) Moderate Load Broadleaf Litter. The primary carrier of fire in TL6 is moderate load broadleaf litter, less compact than TL2. Spread rate is moderate; flame length low.	573	27.83%	3.8	9.5	Surface Fire
TL7 (184) Large Downed Logs. The primary carrier of fire in TL7 is heavy load forest litter, includes larger diameter downed logs. Spread rate low; flame length low.	2	0.10%	2.6	4.2	Surface Fire
TL8 (188) Long Needle Litter. The primary carrier of fire in TL8 is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length is low.	14	0.68%	4.5	9.3	Surface Fire
*TL9 (189) High Load Broad Leaf Litter. The Primary carrier of fire in TL9 is very high load, fluffy broad leaf litter. TL9 can often be used to represent heavy needle drape. Spread rate is moderate; Flame length is moderate.	150	7.29%	6.5	13.9	Passive Crown Fire

*There is no broadleaf litter within the project area. BehavePlus models fire behavior as though the fuel would burn like this. From experience the broadleaf litter models would burn like a combination of mixed conifer, shrub litter and long needle pine.

Post Treatment Fuel Model Conversion

Under Alternative 1, existing fuel models would be converted to another fuel model, typically a fuel model with lower surface fuel loadings and reduced fire behavior. The fuel model conversions shown are used to depict the conditions anticipated in the surface fuel bed changes as a result of the treatments proposed in this alternative. In timbered stands represented as Fuel Model TL6, there would be little or no conversion to a different fuel model as fire behavior would remain the same or have little change. In stands represented by Fuel Model TU5, Alternative 1 would convert to a different fuel model depending on the treatment as described in Table 7. Grass/Shrub models may be present after fuel treatment in isolated areas. Grass/Shrub models occur heavier in some units and are sparse in others, therefore making it difficult to model. These areas would have a higher flame length and rate of spread. Most of these areas would likely receive a mastication treatment therefore they would change to a SB1 and TL5, however the grass would remain unchanged, unless it is burned. Grapple piles, landing piles and hand piles would likely sit for two years at least. They need a full season to cure after that are made. These piles would create a fire hazard until they are burned. Table 7 describes the conversion for each treatment.

Canopy Base Height

Alternative 1 is also anticipated to raise canopy base heights (CBH) with the thinning or removal of ladder fuels. Canopy base height is the lowest height above the ground where there is a sufficient amount of canopy fuel to transition a fire from the surface fuels into the tree crowns. (Scott and Reinhardt 2001), Therefore, low canopy base heights are a critical factor in determining crown fire potential. Fuels treatments should focus on removing some or all of the ladder fuels and other vegetation that contributes to a low canopy base height, especially where reducing crown fire initiation is a priority. The structure and species composition of the stands as well as dense understory trees are contributing to the low canopy base heights observed. Drier sites in the project area tend to have greater variation in stand structure due to small openings in the canopy, but canopy base heights are still low due to the tall shrubs and understory trees. In these forest types, the fuels continuity from the surface fuels to the crown fuels has created the potential for surface fire to propagate to the crowns of the overstory trees. Fire behavior modeling for this project indicates that stands with canopy base heights of less than 4 feet are susceptible to higher crown fire potential. There is a wide range of CBH's throughout the project ranging from 3-30 feet. For modeling purposes a weighted average for CBH of 6 feet was used for current conditions and it was raised to 10 feet after treatment. Behave runs for current conditions within plantations were run with a CBH of 2 feet and post treatment it was raised to 6 feet as these trees are much younger and smaller than other trees within the project area.

Canopy Bulk Density

Alternative 1 will decrease canopy bulk density (CBD) through the thinning of lower and mid-level canopies. It is estimated that, on average, the canopy bulk density will be changed from 0.0041 lb/ft³ to 0.0017 lb/ft³. Canopy bulk density (CBD) is the mass of available fuel per unit of canopy volume (lb/ft³). It is a bulk property of a stand, not an individual tree. CBD is an important crown characteristic needed to predict crown fire spread. Canopy bulk densities were estimated from Landfire outputs for representative stands within the project area as well as comparing site-observations to available research such as Scott and Reinhardt (2001). Dense stands within the project area can have a CBD of 0.0099 lb/ft³, however averages were 0.0041 lb/ft³.

Table 7 Conversion of post treatment fuel models

Current Fuel Model	Fuel treatment	Post treatment fuel model conversion	Flame length in feet	Rate of Spread in chains per hour	Fire Type
GS2, TU5, TL6, TL9	Grapple pile burn	75% TL6	3.8	9.5	Surface Fire
		25% TL1	.8	1.4	Surface Fire
GS2, TU5, TL6, TL9	Mastication	50% SB1	4.2	9.7	Surface Fire
		50% TL5	2.9	7	Surface Fire
GS2, TU5, TL6, TL9	Hand pile burn	50% TL8	4.5	9.3	Surface Fire
		50% TL6	3.8	9.5	Surface Fire
GS2, TU5, TL6, TL9	Jackpot Burn	50% TL1	.8	1.4	Surface Fire
		50% TL6	3.8	9.5	Surface Fire
GS2, TU5, TL6, TL9	Underburn	50% TL1	.8	1.4	Surface Fire
		50% TL3	1.4	2.7	Surface Fire

Indicators

Fire Type -There are three types of fire that are indicators for modeling. They are surface fire, passive crown fire and active crown fire. Each is described in detail below.

- **Ground or Surface Fire** –“Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation” (National Wildfire Coordinating Group, NWCG glossary of terms). Surface fire is important to measure because much of the Big Jack East Project Area historically burned as a surface fire with lower amounts of tree mortality than higher intensity fires. Surface fire is the desired condition for the Big Jack East Project.
- **Passive Crown Fire** – “A fire in the crowns of trees in which trees or groups of trees torch, ignited by the passing front of the fire. Dense areas of vegetation could allow fire to carry into the crowns but then allow it to drop back down to a surface fire once the continuity of the vegetation would break up” (National Wildfire Coordinating Group, NWCG glossary of terms).
- **Active Crown Fire** –“A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other. An active crown fire will kill

most of the vegetation in its path. Because of the higher temperatures, crown fire can significantly alter soils, while the lack of live vegetation post crown fire can significantly increase erosion” (National Wildfire Coordinating Group, NWCG glossary of terms).

- **Rate of Spread (ROS)** – “The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history. In this report it will be discussed in feet per minute. As fire increases in speed, the ability of humans to contain the fire decreases” (National Wildfire Coordinating Group, NWCG glossary of terms).
- **Flame Length** – “Flame length is measured by the distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), and is an indicator of fire intensity” (National Wildfire Coordinating Group, NWCG glossary of terms). “When Flame Lengths are less than four feet fire can generally be attacked at the head or flanks by firefighters using handtools. Flame lengths between 4 and 8 feet fires are too intense for direct attack on the head by firefighters using handtools. Equipment such as dozers, fire engines, and retardant aircraft can be effective when flame lengths exceed 4 feet. When flame lengths are in between 8 and 11 feet fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head would probably be ineffective. When flame lengths are greater than 11 feet crowning, spotting, and major fire runs are probable and control efforts at the head of fire are ineffective” (Andrews and Rothermel 1982). Table 8 outlines the effectiveness of certain firefighting resources on certain flame lengths.

Table 8 Fire Suppression Interpretations of Flame Length and Fireline Intensity

Flame Length (feet)	Fireline Intensity (BTU/ft/s)	Interpretation
<4	<100	Fire can generally be attacked at the head or flanks by firefighters using handtools. Handlines should be successfully held.
4 – 8	100 – 500	Fires are too intense for direct attack on the head by firefighters using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, fire engines, and retardant aircraft can be effective.
8 – 11	500 – 1,000	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head would probably be ineffective.
>11	>1,000	Crowning, spotting, and major fire runs are probable. Control efforts at the head of fire are ineffective.

Source: Andrews and Rothermel 1982

VII. Environmental Consequences

Alternative 1-Action

Fire type (surface fire, passive crown fire and active crown fire) Potential:

Following surface fuel treatments such as grapple pile/burn, mastication, hand pile/burn and underburn treatments fire type would be converted from passive crown fire to a surface fire over 96% of project area under 90th percentile conditions. Current conditions show 69% of the project area as passive crown fire according to fire behavior modeling. Alternative 1 brings crown fire potential down considerably as compared to current conditions.

There may be some areas such as leave areas where fire could get up into the crowns of trees however this would be in isolated areas. Leave areas encompass 68 acres or 4% of the entire project area. Leave areas are only within the threat zone which is ¼ mile from private property. Additionally, if fire did get into the crowns it could not be sustained because of the treatment around leave areas. Further, if a wildfire did ignite following the treatments under the Proposed Action, fire fighters would most likely be able to utilize all resources available for direct attack, given 90th percentile weather conditions. Alternative 1 does meet desired conditions by reducing surface and ladder fuel conditions so that crown fire ignition is highly unlikely. After treatment the openness and discontinuity of crown fuels both horizontally and vertically will result in very low probability of sustained crown fire. Once prescribed fire is completed within the leave areas the probability for wildfire to get into the crowns of trees is very low.

Table 9 Fire Type comparison for treatment methods

Crown Fire Potential or Fire Type (Acres and percentage of treatment area)						
	Current Condition	Grapple Pile/Burn	Mastication	Hand Pile/Burn	Jackpot Burn	Underburn
Surface Fire	637 (31%)	1,883 (96%)	1,883 (96%)	108 (100%)	1,951 (100%)	1,951 (100%)
Passive Crown Fire	1,422 (69%)	68 (4%)	68 (4%)	0	0	0
Active Crown Fire	0	0	0	0	0	0

Flame Length:

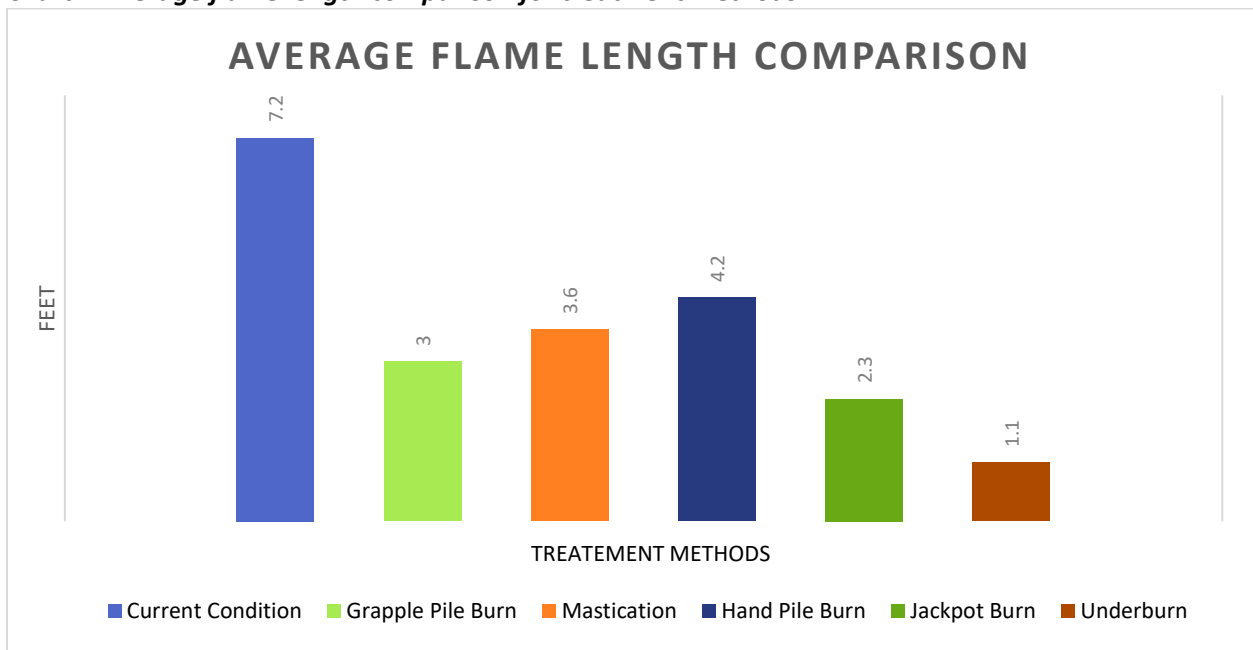
Current conditions for Flame Length across the entire project area are between 3.8 and 9.7 feet with a weighted average of 7.2 feet. With treatments under the Proposed Action designed to reduce ladder and surface fuels, potential wildfires flame lengths would be less than 4 feet in most treatments for each treatment as described in Table 2 below. Modeling of potential post-treatment wildfire behavior under the Proposed Action shows that in:

- Grapple pile and burn units flame lengths would be between 0.8 and 3.8 feet with a weighted average of 3 feet. The weighted average assumes approximately 25% of a given area would be burned due to the amount of piles and pile placement.
- Masticated units flame lengths would be between 2.9 and 4.2 feet with an average of 3.6 feet
- Hand pile and burn units flame lengths would be between 3.8 and 4.5 feet with an average of 4.2 feet
- Jackpot burning would be between 0.8 inches and 4.5 feet with an average of 2.7 feet
- Underburn units flame lengths would be 0.8 and 1.4 feet with an average of 1.1 feet.

Table 10 Flame length comparison for treatment methods

Flame Length in feet (Acres and percentage of treatment area)						
	Current Condition	Grapple Pile/Burn	Mastication	Hand Pile/Burn	Jackpot Burn	Underburn
0-4 feet	592 (29%)	1,883 (96%)	941.5 (48%)	54 (50%)	1,951 (100%)	1,951 (100%)
4-8 feet	526 (25%)	0	941.5 (48%)	54 (50%)	0	0
8+ feet	941 (46%)	68 (4%)	68 (4%)	0	0	0

Chart 1 Average flame length comparison for treatment methods



Modeling also displays that flame lengths over 4 feet would occur in hand pile and burn units, leave areas and isolated areas where grass and shrubs are present. With treatments under the Proposed Action designed to reduce ladder and surface fuels, a potential wildfires flame lengths would be less

than four feet in most treatment areas. Hand pile and burn units cover approximately 5% of the project area and leave areas cover 4% of the project area for a total of 9%. Therefore, 9% or 176 acres may experience flame lengths over 4 feet. The remaining 1,883 acres would display flame lengths under 4 feet. There may be some isolated areas where a grass/shrub model is present where flame lengths may be over 4 feet within the 1,883 acres. Fires with flame lengths less than 4 feet require fewer suppression resources, are the easiest to control, cost less money to control, and pose the least amount of danger to wildland firefighters. While higher intensity fire (as indicated by flame length) would not be eliminated from the landscape under the Proposed Action, this type of behavior would occur in smaller amounts after treatment. Alternative 1 meets desired conditions by reducing flame lengths in most areas to less than 4 feet.

Rate of Fire Spread:

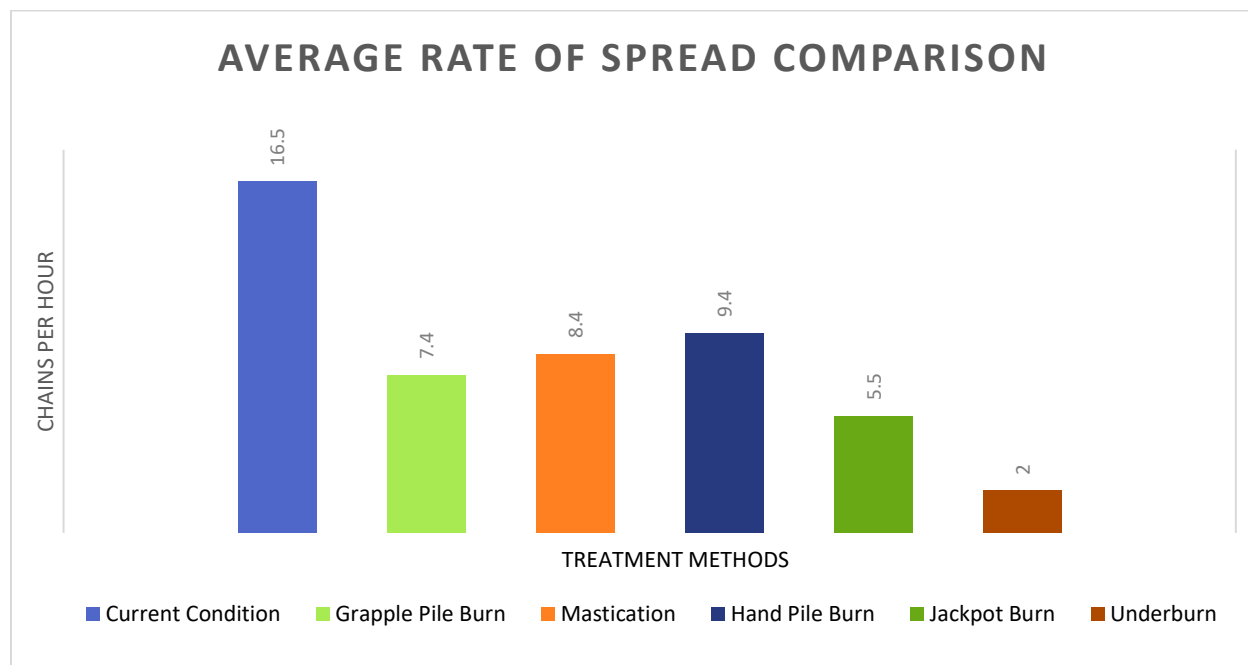
After initial treatment the rate of spread is lessened by 69% across the entire project area as compared to no treatment. 1,883 acres would be expected to experience a ROS of 0-10 ch/hr. A slow moving fire (less than 10 ch/hr.) would not be a stand replacing fire but more of a surface fire which is more likely to be contained and controlled. A hand crew would most likely be able to out flank a fire in a treated unit whereas in an untreated unit a handcrew would not be able to do so.

- Grapple pile and burn units ROS would be between 1.4 to 9.5 chains per hour with a weighted average of 7.5 ch/hr. The weighted average assumes approximately 25% of a given area would be burned due to the amount of piles and pile placement.
- Masticated units ROS would be between 7 and 9.7 chains per hour with an average of 8.4 ch/hr.
- Hand pile and burn units ROS would be between 9.3 and 9.5 chains per hour with an average of 9.4 ch/hr.
- Jackpot burn units ROS would be between 1.4 to 9.5 chains per hour with an average of 5.5 ch/hr.
- Underburn units ROS would be 1.4 to 2.7 chains per hour with an average of 2 ch/hr.

Table 11 Rate of Spread comparison for treatment methods

Rate of Spread in chains per hour (Acres and percentage of treatment area)						
	Current Condition	Grapple Pile/Burn	Mastication	Hand Pile/Burn	Jackpot Burn	Underburn
0-10 ch/hr.	636 (31%)	1,883 (96%)	1,883 (96%)	108 (100%)	1,951 (100%)	1,951 (100%)
10-20 ch/hr.	1,091 (53%)	68 (4%)	68 (4%)	0	0	0
20+ ch/hr.	332 (16%)	0	0	0	0	0

Chart 2 Average rate of spread comparison for treatment methods



The above chart displays that the rate of fire spread would be less than 10 chains per hour on average across the entire project area. When rate of spread is under 10 chains per hour direct attack with handline is likely to be successful. The slower a fire moves the more time resources have to contain/control a fire. More time is always a better scenario when trying to control a fire. Prescribed fire will reduce the ROS by more than 50% within those treatment areas. Alternative 1 does meet desired conditions by reducing the rate of spread by 50%.

Fireline Production Rates

This table was taken from the Fireline Production Rates, U.S. Department of Agriculture Forest Service National Technology & Development Program 5100—Fire Management 1151 1805—SDTDC April 2011

Table 12 Sustained line production rates of 20-person crew in chains per hour

Fire Behavior Fuel Model	Current Rates for Type 1 crew	New Rates for Type 1 crew
1 Short Grass	30	17
2 Open Timber Grass	24	17
3 Tall Grass	5	5
4 Chaparral	5	6.6
5 Brush	6	16.5
6 Dormant Brush/hard wood slash	6	16.5
7 Southern rough	4	4
8 Closed timber littler	7	10.5
9 Hardwood litter conifers	28	10.5

9 Hardwood litter hardwoods	40	10.5
10 Timber Litter and Understory	6	10.5

Desired condition of post treatment is to double line production rates. The current line production rate would be in fuel model 10 a timber litter with understory. After treatment it would resemble a fuel model 2, a more open stand without shrubs and ladder fuel. According to current rates for line production this need would be met. The new rates show line production rates are not quite doubled, however from experience fire managers know that line production rates will be much faster after treatment.

Alternative 2-No Action

Alternative 2 would not reduce hazardous fuel loading, nor take any action to modify landscape scale wildland fire behavior. Under Alternative 2, the existing threat of wildfire would remain, and the Project's fire and fuels goals would not be met. There would be no change from the current condition. In addition, fuel would continue to accumulate and ladder fuels and shrubs would continue to grow making the wildfire threat worse every year.





Fire Type

Under the No Action Alternative, an estimated 1,422 acres or 69% of the project area is projected to act as a passive crown fire under 90th percentile weather conditions. Surface fire is projected on 637 acres or 31 % of the project area. Passive crown fire is projected to occur throughout the entire project area including the defense zone. If the area remains untreated such a fire could damage or destroy structures as well as put people present at danger. Fires that get into the crowns of trees are very difficult to control, pose a larger threat to firefighters and public, are damaging to forest structure, and are a threat to homes that are adjacent to the project. Alternative 2 does not meet desired conditions by reducing surface and ladder fuel conditions so that crown fire ignition is highly unlikely.

Flame Length

Under the No Action Alternative current conditions show that flame lengths over 8 feet would occur on 941 acres or 46% of the project area. Flame lengths over 8 feet require mechanized equipment, air support and are difficult to control. Flame lengths between 4 and 8 feet are projected to occur on 526 acres or 25% of the project area. Flame lengths under 4 feet would occur on 592 acres or 26% of the project area. Fires that have flame lengths greater than 4 feet require more suppression resources, are difficult to control, and pose the most danger to wildland firefighters. Further, fires of this nature cost more money to suppress, rehabilitate and are the most destructive to the landscape. These larger fires are generally stand replacing type fires. Alternative 2 does not meet desired conditions by reducing flame length to less than 4 feet. Flame lengths would remain the same and the potential to get higher would increase every year as more fuel accumulates and vegetation continues to grow. The chart below represents what fire suppression tactics are needed to effectively suppress a fire.

Table 13 Relationship of surface fire flame length and fireline intensity to suppression interpretations.

Flame length		Fireline intensity		Interpretation
ft	m	Btu/ft/s	kJ/m/s	
< 4	< 1.2	< 100	<350	 <ul style="list-style-type: none"> Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 – 8	1.2 – 2.4	100 – 500	350 – 1700	 <ul style="list-style-type: none"> Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 – 11	2.4 – 3.4	500 – 1000	1700 – 3500	 <ul style="list-style-type: none"> Fires may present serious control problems—torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective
> 11	> 3.4	> 1000	> 3500	 <ul style="list-style-type: none"> Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Rate of Spread

Under the No Action Alternative it is predicted that a rate of fire spread greater than 20 chains per hour is estimated to occur on 332 acres or 16% of the project area. A ROS between 10-20 ch/hr. is projected on 1,091 acres or 53% of the treatment acreage. A ROS less than 10 ch/hr. is projected on 636 acres or 31% of the treated area. The average ROS across the entire project area is between 9.5 and 39.7 ch/hr. with a weighted average of 16.5 ch/hr. Alternative 2 does not meet desired conditions by decreasing ROS by 50%. Rate of spread would continue to get faster year after year as fuel continues to accumulate and vegetation continues to grow.

Under the No Action Alternative (Alternative 2), fire severity potential and fuel loading in the area would increase in the future from current conditions. Surface and ladder fuels would continue to build, increasing the future probability of severe wildfires. Alternative 2 would increase the susceptibility of forest stands to disturbances, such as fire, insect, and disease outbreaks, over time as fuel loadings would continue to increase due to conifer mortality and increasing stand densities. Fire control tactics could be far more costly and less effective if the proposed activities were foregone and the disturbance processes, such as fire or insect and disease outbreaks, occurred. Costs of wildfire suppression and emergency rehabilitation would be expected to continue to rise as they have in the past.

Wildfire is inevitable in the Sierra Nevada Mountains and has threatened the project area several times over the decades. At some point during fire suppression activities a decision has to be made - whether it is safe enough for firefighters to fight the fire (direct attack) or to allow the fire to run its course (indirect attack) until it becomes safe enough to suppress. To avoid wildfire threatening the project area and surrounding areas, firefighting efforts need to have the opportunity for a high degree of success. Firefighters and law enforcement agencies need to have the ability to safely evacuate the general public

if needed and have as safe a working environment as possible to conduct firefighting operations. Depending on conditions, Alternative 2 would provide a lower likelihood of a safe environment for firefighters during wildfire suppression actions compared to Alternative 1.

Fireline Production Rates

Fireline production rates would not change under the No Action alternative, therefore they do not meet desired conditions of doubling fireline production rates.

Alternatives Compared

Fire type

Alternative 1 provides for the most surface fire which will make fire suppression more successful. Alternative 2 would leave areas the most susceptible to passive crown fire while minimizing opportunities for lower severity surface fire under 90th percentile weather conditions. Alternative 1 is projected to result in 96% ground fire and 4% passive crown fire under 90th percentile conditions. Under Alternative 2, 31% of the treatment acreage proposed is projected to carry surface fire while the remaining 69% of the treatment acreage proposed under Alternative 2 would sustain passive crown fire. If the area remains untreated such a fire could damage or destroy structures as well as put people present at danger. Fire Type would not be changed if no action is taken. Fires that get into the crowns of trees are very difficult to control, pose a larger threat to firefighters and public, are damaging to forest structure, and are a threat to homes that are adjacent to the project. Alternative 1 would decrease fire type from passive crown fire to primarily ground fire in the treatment areas. Alternative 1 would meet desired conditions by reducing surface and ladder fuels so that crown fire ignition is highly unlikely. Treated areas would reduce fuel both horizontally and vertically, creating more open crowns that result in very low probability of sustained crown fire. Alternative 2 does not meet desired conditions.

Flame length

Of the alternatives, Alternative 1 has the most acreage on which flame lengths are projected to be less than 4 feet. As discussed earlier, this allows for most firefighting strategies to be utilized. Alternative 2 would allow for flame lengths on 592 acres or 29% of the area to have less than 4 feet. Fire suppression would be more successful under Alternative 1 due to flame lengths less than 4 feet in the majority of the treated areas. Under Alternative 2, approximately 941 acres would have flame lengths over 8 feet. Direct attack of a wildfire will be difficult with flame lengths over 8 feet. Flame lengths of this scale would most likely get into the crowns of trees and create passive crown fire. Alternative 1 meets desired conditions by reducing flame lengths in most treatment areas to under 4 feet whereas Alternative 2 does not.

Rate of Spread

Of the two alternatives, Alternative 1 has the lowest rate of fire spread. Alternative 2 has the highest rate of fire spread, which would make it difficult and unsafe for fire suppression activities. Rate of Spread under Alternative 1 is decreased to less than 10 ch/hr. across 96% of treated acreage. Alternative 2 shows a ROS less than 10 ch/hr. across 31% of the proposed treatment unit acreage.

It is understood that a slow moving fire will not be a stand replacing fire but more of a surface fire which is more likely to be contained and controlled. As stated earlier, a Type 1 handcrew would just be keeping up with the ROS in treated areas. A hand crew would most likely be able to out flank a fire in a treated unit whereas in an untreated unit a handcrew would not be able to do so. Mechanized equipment would be needed in areas where the fire would be moving faster than 20 ch/hr....

Alternative 2 displays that 332 acres or 16% of the proposed treatment area would maintain a ROS greater than 20 ch/hr. ROS between 10 and 20ch/hr. would occur on 1,091 acres or 53% of the proposed treatment area. ROS less than 10 ch/hr. would occur on 636 acres or 31% of the proposed treatment area. It is understood that a slow moving fire will not be a stand replacing fire but more of a surface fire which is more likely to be contained and controlled.

Further, as stated earlier in the document ROS is an important indicator because it can be compared with the amount of time various firefighting resources need to control and contain a fire. For example, for sustained line production, including burnout and holding activities, a 20 person type 1 handcrew can produce 6 chains per hour in current conditions for most fuel types in the Big Jack East project area. Therefore, if ROS exceeds 6 chains per hour then this firefighting resource cannot be used for direct attack. The fastest direct attack resources, in terms of production rates, are dozers. They can generally build line as fast as 25 chains per hour under ideal conditions. Consequently, if fire rate of spread exceeds 25 chains an hour, it is understood that direct attack would be unsuccessful and only indirect attack strategies could be utilized which are much less successful and safe.

Fireline Production Rates

Fire line production rates would be doubled in Alternative 1 as compared to no treatment. When fuels are removed prior to a fire starting, crews are able to move much faster as there is not as much vegetation to cut and dig through. The firefighting environment would be much safer under alternative 1 because there will be less snags encountered when engaged in fire suppression activities.

Fire Behavior within Leave Areas, Create Openings, Plantations, Down Woody Material and Snags

Early observers in unharvested or “virgin” forests associated with frequent fire consistently noted that trees were grouped or clustered, as opposed to regularly spaced (Dunning, 1923; Cooper, 1961), and uneven aged, or “at best even-aged by small groups” (Show and Kotok, 1924). Historical data and stand reconstructions indicate that conifer-dominated forests throughout the western US appear to have shared a similar structure, with widely spaced individual trees, groups of trees, and canopy openings organized at 0.1–0.3 ha spatial scales (Larson and Churchill, 2012). This “patchy and broken” structure contributed to the relative immunity of historical forests to crown fire (Show and Kotok, 1924). Because surface fuels are a product of overstory structure and composition (Lydersen et al., 2015), variability in overstory conditions presumably led to surface fuel discontinuity, which likely limited spread of higher intensity fire (Miller and Urban, 2000). Given the environmental stress forest ecosystems are likely to experience under a changing climate, heterogeneity may be particularly important in shaping stand resilience to wildfire and other disturbances (Drever et al., 2006; Stephens et al., 2010)

Leave Areas (LA)

The proposed action would have about 68 acres of LA's which covers approximately 4% of the project area. LAs are small existing areas, ranging in size from 0.1-2.25 acres, within treatment units that provide continuous vertical and horizontal cover. Fire behavior within these areas would not change from current conditions. Most of these areas are composed of a timber/shrub fuel model which would have a higher flame length and higher rate of spread as compared to treated areas.

Prescribed fire over the long term could be an important management tool within LAs. For LAs comprised of multiple sizes of trees, snags, and down wood, prescribed fire would be carefully applied to maintain key habitat elements, particularly snags and down wood. While underburning in LAs would likely result in some mortality of suppressed and subdominant trees, burning prescriptions would be designed and implemented to retain the overall structure of the LAs.

Create Openings (CO)

The proposed action would have about 54 acres of openings which covers approximately 4% of the project area. These openings COs would be small areas, ranging in size from 0.1-1.25 acres, where all trees under 29.9 inches dbh would be removed. Typically these areas are comprised of existing clumps of dense, younger, and smaller diameter trees. It is important to note that COs would not be created in the defense zone. Fire behavior within the CO's would typically be a surface fire with low rate of spread and low flame lengths. However, a grass/shrub fuel model may fill into these areas over time if they receive a lot of sunlight. A grass/shrub fuel model would have a higher rate of fire spread and a higher flame length. It would be important to maintain these areas with prescribed fire or other surface fuel reduction tools.

Prescribed fire over the long term would be an important management tool within COs. Within COs, prescribed fire would be applied to regenerate shrubs and create suitable areas for shade-intolerant tree species to regenerate.

Snag density and down woody material

The proposed action would reduce the overall snag population, particularly smaller snags (less than 15 inches dbh) and would concentrate the retention of most snags in areas that have the potential for lower intensity fire. Snags would not be retained in the defense zone or along logical fire control lines (i.e. existing roads and trails). Snags can create some problems with fire behavior and fire suppression activities. First, snags may not increase rate of spread or flame length but are a ready receptor for embers which can cause spot fires that can be difficult to detect and extinguish. Those same snags can in turn increase the likelihood of more spot fires started from their embers displaced by wind. Second, snags can be dangerous for firefighters to work around depending on the type of tree, soundness of the tree, and length of time since death. Firefighters are very aware of snag safety as well as working around snags, which makes mitigation of hazards possible in most situations.

Large down wood would not be retained in the defense zone or along logical fire control lines (i.e. existing roads and trails). The Proposed Action has approximately 68 acres of Leave Areas (LA) to be

retained within WUI Threat Zone. LAs are small existing areas, ranging in size from 0.1-2.25 acres, within treatment units that provide continuous vertical and horizontal cover. Areas designated as LAs may contain multiple wildlife habitat elements such as: large down woody material, a mixture of tree age classes (including solitary and groups of large trees), large snags, multiple tree canopy layers, and/or trees with features associated with wildlife use (for example, platforms, mistletoe brooms, forked tops, and cavities). LAs would contribute to/enhance within-stand horizontal and vertical structural diversity and provide important old forest and/or mid-seral habitat elements. Prescribed fire over the long term could be an important management tool within LAs, although only one entry would occur with this Project. The presence of larger down logs can increase the resistance to control and are ready receptors of embers, which can cause spot fires. Large down logs can also burn for a long period of time at high intensities which can make suppression and mop up more difficult. In general, large down material does not increase rate of spread or flame length and considering the project will be reducing the amount of down material, some retention in isolated areas is still commensurate with the fuel management needs of the BJE Project.

Plantations

There are several plantation units throughout the project area. These areas consist of younger trees of similar size and species composition. Trees are growing with crowns touching and uniform in spacing. The general size of trees is from 6-16" in dbh. Initial treatment within plantation units would focus on removing trees less than 11" dbh. This treatment would result in residual tree spacing of approximately 20' by 20', allowing for some variability and to meet fuel management goals. Treatment would retain the healthiest trees in the following order of priority: sugar pine, ponderosa pine/Jeffrey pine, lodgepole pine and white fir. As needed to meet desired WUI conditions, a secondary treatment would follow the initial mechanical treatment as soon as practicable.

Without treatment it would be expected that passive crown fire, higher flame lengths and a greater rate of spread as well as a 80% probability of mortality would occur throughout these areas. Post treatment it is expected that some mortality will occur due to the thin bark of the trees however it is much less than if no treatment occurs.

Predicted Fire Behavior for Plantations				
	Fire Type	Flame Length	ROS	Probability of Mortality
Current Conditions	Passive Crown fire	8.5	26.9	80%
Post treatment	Surface Fire	3.3	7.7	11.5%

VIII. Direct and Indirect Effects

Direct Effects of Alternative 1

Implementing Alternative 1 prescriptions would decrease ROS, flame length and the opportunity for crown fires to occur. Consequently, large scale wildland fire behavior would be modified. Wildland fire behavior would be reduced and costs of wildfire suppression and emergency rehabilitation could be lessened with the avoidance of stand replacing fire. Therefore, Alternative 1 would meet fire and fuels goals and objectives. Alternative 1 would decrease the susceptibility of treated stands to disturbances such as fire, insect, and disease outbreaks. Fire line production rates would be doubled in Alternative 1 as compared to no treatment. When fuels are removed prior to a fire starting, crews are able to move much faster as there is not as much vegetation to cut and dig through. The firefighting environment would be much safer under alternative 1 because there will be less snags encountered when engaged in fire suppression activities. Further, when the canopy is opened retardant drops are much more effective as the retardant can reach the surface fuels.

Indirect Effects of Alternative 1--Proposed Action

As previously stated, areas where fuels have been treated burn at lower intensities compared to untreated areas, which in turn would reduce damage to the treated stands from potential future wildfire. Alternative 1 prescriptions would decrease ROS, flame length and the opportunity for crown fires to occur. Wildfires enter the untreated stands at lower intensities, reducing damage to these areas. Fires burning at lower intensities would allow firefighters to have the upper hand on fire suppression and they would most likely be able to contain a low intensity fire quickly.

Direct Effects of Alternative 2

If no action occurs surface and ladder fuels would continue to build, increasing the future probability of larger scale fires, burning at higher intensities. ROS, flame length, and crown fires would continue to increase. Further, the risk of larger landscape scale wildland fire behavior would continue to rise. Retardant drops would not be successful in a closed canopy as the retardant cannot penetrate to the surface fuels where it is effective. Costs of wildfire suppression and emergency rehabilitation would remain high if a stand replacing fire did affect the project area under 90th percentile weather in its current condition. Fire and fuels goals would not be met if the buildup of heavy fuel loading continues to contribute to high wildfire intensities.

Indirect Effects of Alternative 2

If no action occurred within the Big Jack East Project Area, there would be an increase in the susceptibility of stands to disturbances such as fire, insect, and disease outbreaks over time as fuel loadings continue to increase due to conifer mortality and increasing stand densities. Fire control tactics would most likely be very costly and less effective if the disturbance processes such as fire or insect and disease outbreaks occurred in the Project area's current condition. Therefore, fire and fuels goals would not be met if large scale wildland fire behavior continued to be a threat. Fuel loading within untreated stands will continue to accumulate at a higher rate than treated stands. If a wildfire starts within the project area without treatment and is able to establish itself, fire suppression is likely to be difficult and

dangerous. Further, more resources will be needed and a fire with potential flame lengths greater than 8 feet will cost more money and is understood to be more destructive to the landscape.

Without disturbance, surface and ladder fuels would continue to build, increasing an already high probability of larger scale fires, burning at higher intensities in untreated areas. Costs of wildfire suppression and emergency rehabilitation would remain high if a stand replacing fire did affect the Project area under 90th percentile weather in untreated areas. Fire and fuels goals would not be met if the buildup of heavy fuel loading continues to contribute to high wildfire intensities.

Long term fire behavior for Alternative 1

Post treatment fire behavior such as flame length and rate of spread after treatment will continue to increase slightly year after year due to vegetation regrowth and the accumulation of forest litter. The buildup of fuel and vegetation growth is what drives wildland fire (along with weather and topography). It is difficult to model fire behavior post treatment because of landscape diversity and the dynamic ecological functions that make precise spatial fuel pattern prediction impossible with current technologies. However one can estimate potential fire behavior by looking at current conditions that were treated in the past and assume a certain amount of plant succession into the future.

The project area was treated in the past 20-30 years with similar fuel treatment methods that are being proposed now. Therefore, it is understood that future conditions post treatment, in many places within the project, could resemble what is present after a similar period in time if no maintenance or natural disturbance occurs.

Where openings occur it is expected that vegetation would come in more quickly than in shaded areas. Based on site conditions and on-the-ground evaluations, revegetation would occur within these openings 1) by planting a variety of shade intolerant tree species; 2) by planting a different genetic strain of shade intolerant tree species already on site; or 3) naturally by local shrub sprouting and tree, shrub, and herbaceous seed sources, or a combination thereof. Grass/shrub fuel models will have a higher flame length and higher rate of spread as compared to a timber litter model. However rate of spread and flame length will also increase over the long term in timber litter models as plant succession inevitably occurs. Although it is understood to be slower and more sporadic as compared to the grass/shrub model.

It is expected that shade tolerant trees such as white fir would start to regenerate in shaded areas with no further disturbance. As canopy base heights decrease, these trees will become ladder fuels which can initiate crown fire in 90th percentile weather.

Shaded areas as compared to open areas and fire behavior

As pointed out above shrubs and grass would come in more quickly as compared to shaded areas, however most shrub and herbaceous species in the project area's bioclimatic environment normally reach their mature height of less than 6 feet before growing more slowly than when they first sprouted/and or seeded. Concurrently, shade tolerant trees such as white fir would begin to grow within shaded areas. These trees generally grow slower than shrubs but don't reach mature heights of greater than 80 feet for some time, and will continue to grow at a steady rate into the canopy of the larger trees, thus lowering crown base heights which make it easier for crown fire to initiate. Therefore

continued maintenance of all treatment areas will be critical to maintain conditions that will be resilient to high severity fire.

Undisturbed Shaded vs unshaded models	Flame length in feet	Rate of Spread in chains per hour	Fire Type
Openings GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic). The primary carrier of fire in GS2 is grass and shrubs combined. Shrubs are about 1 to 3 feet high, grass load is moderate. Spread rate is high; flame length moderate. Moisture of extinction is low. May include small trees under 3 feet.	7.3	39.7	Passive Crown Fire
Shaded white fir encroachment TU5 (165) Very High Load, Dry Climate Timber-Shrub. The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.	9.7	14	Passive Crown Fire

IX. Cumulative Effects

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one cannot reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, focusing on the impacts of past human actions risk ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. Third, public scoping for this project did not identify any public interest or need for detailed information on individual past actions. Finally, the Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, “agencies can conduct an adequate cumulative effects

analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions”.

The cumulative effects analysis area for fuels within the forest stand generally encompasses the Big Jack East project area with an added 1/4 mile circumference beyond the project area. This 3,645 acre area includes both National Forest System and private lands, and was selected to capture landscape-level effects of management actions on forest stands. The cumulative effects analysis temporal scale extends 20 years before and after the present, corresponding with the estimated longevity of vegetation/fuels treatments.

Recent and ongoing activities on over the past 20 years include; thinning, prescribed burning, and other fuels reduction activities within the project area. Large areas of mastication has been accomplished on private land surrounding the project area. These activities have and will have positive effects to the fuels situation. However, overall these recent and ongoing actions have not addressed landscape fuels management and urban intermix protection needs for the Big Jack East analysis area.

Foreseeable future actions include additional fire-wise program activity currently being planned with the Truckee CWPP as directed by federal wildland fire policy and due to the fact the project area is within and adjacent to the Wildland Urban Intermix. However, no significant activity on national forest lands are planned to address vegetation or fuels within the Big Jack East analysis area. Aggressive fire management actions will likely continue within the analysis area.

Cumulative Effects under Alternative 1

Under the Proposed Action Alternative (Alternative 1), landscape scale wildland fire behavior would be modified through the reduction of hazardous fuel loading within the fuels cumulative effects area. The cumulative effects of this project could encompass up to 3,645 acres. If firefighters are given a place to successfully engage in fire suppression, there is a chance at keeping the fire smaller. This leads to a positive net effect over the entire fuels cumulative effects area due to the placement and size of the proposed action. Treatment areas would also augment reforestation efforts of the past by creating more fire resilient forest stand structures. Alternative 1 would reduce flame lengths, ROS, and fire type (compared to existing conditions) in proposed treatment areas. Untreated areas would likely benefit as well, in terms of fire behavior moderations, from surrounding reductions in flame length, ROS, and fire type. Wildfire could be contained or controlled before it reached untreated areas, or it could move through untreated areas but could be more easily suppressed when it reached a treated area.

Ultimately, the cumulative effects of the placement and size of treatment areas under Alternative 1 would benefit the larger landscape by moderating landscape scale fire behavior. Therefore, Alternative 1 would result in a positive cumulative effect on forest stands in the analysis area over the 20-year cumulative effects analysis temporal scale.

Under the Proposed Action Alternative (Alternative 1), forest stands would improve in structure and resilience with a positive net effect over the entire fuels cumulative effects area. This is generally due to the decrease in competition among all remaining trees in both past and proposed action units as well as

the presence of some larger scale variability in past action units and the multi-scaled variability resulting from proposed action treatments. Further, where treatment units overlap with some of the homogenous treatments of the past, prescriptions aim to not only take advantage of the positive attributes of past treatments (such as reducing competition around larger trees), but are designed also find opportunities to introduce more heterogeneity within them. Past treatment areas that do not overlap with Alternative 1 treatments would most likely continue to develop aided by the increased resiliency from surrounding treatments, but with minimal smaller scale and strategically introduced variability. Ultimately, the cumulative effects of the past and present treatments combined with Alternative 1 treatments would benefit individual tree growth and resiliency within all units (historical, present or proposed), and by having reduced competition within all units, larger scale disturbances that could occur within the fuels cumulative effects area would most likely be interrupted. Therefore, Alternative 1 would result in a positive cumulative effect on forest stands in the analysis area over the 30-year cumulative effects analysis temporal scale.

Cumulative Effects under Alternative 2

Past, present, and future actions within the analysis area have minimal cumulative effects in terms of modifying landscape-level fire behavior. Under the “No Action” Alternative (Alternative 2), the fuels cumulative effects area would continue to be at risk for severe landscape scale wildland fire behavior. The current declining forest health trends would continue in the fuels cumulative effects area, particularly outside of past treatment area boundaries. Fuel loading would continue to increase, leading to an increase in fire behavior variables, including rate of spread, flame length, and fire type. Past treatments could provide places for firefighters to engage in wildfire suppression activities. To summarize, past and present actions have minimal impacts on modifying landscape fire behavior because it has been over 20 years since large scale treatments have occurred. Vegetation has grown and surface fuel continue to build from past treatments. While there are no reasonably foreseeable future actions aimed at modifying fire behavior, ongoing fire exclusion would continue to allow fuels to accumulate and absence of action under Alternative 2 to reduce hazardous fuels would add to this effect.

Under the “No Action” Alternative (Alternative 2), current declining forest health trends would continue in the fuels cumulative effects area, particularly outside of past treatment unit boundaries. Stand densities would continue to increase and forest fuels would continue to accumulate. Implementation of Alternative 2 would result in adverse indirect impacts on forest health, specifically stand density and tree species composition. Past treatment areas would most likely continue to develop, but would be at a higher mortality risk from disturbances from surrounding untreated stands.

In the absence of disturbance, such as wildfire, shade-intolerant tree numbers would decline due to lack of sunlight. Structural diversity would slowly improve as large trees died and created gaps for regeneration. Because of the limited amount of light reaching the forest floor, most regeneration would be shade-tolerant species, such as white fir. White fir is less able to tolerate drought or fire than the less shade-tolerant pines. These trees grow in densely, therefore creating a high fire hazard.

Alternative 2 would result in adverse indirect impacts on fire behavior. Fuel loading would continue to build in past treatment areas, but would do so at lesser amounts because there are fewer trees to drop needles and timber litter. Plantations would continue to be at risk for large scale wildfires. Therefore, Alternative 2 would result in a negative cumulative effect on fire behavior over the 3645 acre cumulative effects analysis area. Treatments that would not only better protect the Big Jack East Project Area but also protect firefighters and the general public from the effects of extreme fire behavior in the event of a wildfire would be foregone. The forest habitat and people visiting or living in the area would remain at risk from severe stand replacing fires created by the excessive fuel loading and the dense tree and shrub growth that exists. Therefore, Alternative 2 would result in a negative cumulative effect on forest stands in the analysis area over the 20-year cumulative effects analysis temporal scale.

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